

Central Radio Propagation Laboratory

IONOSPHERIC PREDICTIONS

*for
April
1964*

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U. S. DEPARTMENT of COMMERCE
National Bureau of Standards
Number 13/Issued January 1964

U.S. DEPARTMENT OF COMMERCE

Luther H. Hodges, Secretary

NATIONAL BUREAU OF STANDARDS

A. V. Astin, Director

Central Radio Propagation Laboratory

Ionospheric Predictions

for April 1964

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[Formerly "Basic Radio Propagation Predictions," CRPL Series D.]

The CRPL Ionospheric Predictions are issued monthly as an aid in determining the best sky-wave frequencies over any transmission path, at any time of day, for average conditions for the month. Issued three months in advance, each issue provides tables

of numerical coefficients that define the functions describing the predicted worldwide distribution of foF2 and M(3000)F2 and maps for each even hour of universal time of MUF(Zero)F2 and MUF(4000)F2.

NOTE: Department of Defense personnel see back cover.

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National Bureau of Standards

The functions of the National Bureau of Standards are set forth in an Act of Congress, March 3, 1901, as amended. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to government agencies on scientific and tech-

nical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. The Bureau also serves as the Federal technical research center in a number of specialized fields.

Central Radio Propagation Laboratory

The Central Radio Propagation Laboratory at Boulder, Colorado, is the central agency of the Federal Government for the collection, analysis, and dissemination of information on propagation of radio waves at all frequencies along the surface of the earth, in the atmosphere, and in space, and performs scientific studies looking toward new techniques for the efficient use and conservation of the radio spectrum. To carry out this responsibility, the CRPL—

1. Acts as the central agency for the conduct of basic research on the nature of radio waves, the pertinent properties of the media through which radio waves are transmitted, the interaction of radio waves with those media, and on the nature of radio noise and interference effects. This includes compilation of reports by other foreign and domestic agencies conducting research in this field and furnishing advice to government and nongovernment groups conducting propagation research.

2. Performs studies of specific radio propagation mechanisms and performs scientific studies looking

toward the development of techniques for efficient use and conservation of the radiofrequency spectrum as part of its regular program or as requested by other government agencies. In an advisory capacity, coordinates studies in this area undertaken by other government agencies.

3. Furnishes advisory and consultative service on radio wave propagation, on radiofrequency utilization, and on radio systems problems to other organizations within the United States, public and private.

4. Prepares and issues predictions of radio wave propagation and noise conditions and warnings of disturbances in these conditions.

5. Acts as a central repository for data, reports, and information in the field of radio wave propagation.

6. Performs scientific liaison and exchanges data and information with other countries to advance knowledge of radio wave propagation and interference phenomena and spectrum conservation techniques, including that liaison required by international responsibilities and agreements.

Introduction

The "Central Radio Propagation Laboratory Ionospheric Predictions" is the successor to the former "Basic Radio Propagation Predictions," CRPL Series D. To make effective use of these predictions, National Bureau of Standards Handbook 90, "Handbook for CRPL Ionospheric Predictions Based on Numerical Methods of Mapping," should be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402, price 40 cents. This Handbook includes required additional data, nomographs and graphical aids, as well as methods for the use of the predictions. The Handbook supersedes the obsolete NBS Circular 465.

The basic prediction appears in tables 1 and 2, presenting predicted coefficients for f_oF_2 and $M(3000)F_2$ defining the numerical map functions describing the predicted worldwide variation of these characteristics. With additional auxiliary information, these coefficients may be used as input data for electronic computer programs solving specific high frequency propagation problems. The basic equations, their interpretation, and methods of using the numerical maps are described in two papers by W. B. Jones and R. M. Gallet, "The Representation of Diurnal and Geographic Variations of Ionospheric Data by Numerical Methods," Volume 66D, Number 4, July-August 1962, pages 419-438, and "Methods for Applying Numerical Maps of Ionospheric Characteristics," Volume 66D, Number 6, November-December 1962, pages 649-662, both in the Journal of Research of the National Bureau of Standards, Section D. Radio Propagation. The predicted numerical map coefficients of tables 1 and 2 may be purchased in the form of a tested set of punched cards. Write to the Prediction Services Section, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado, to arrange for the purchase of the set of punched cards and for further information and assistance in the application of computer methods and numerical prediction maps to specific propagation problems.

The graphical prediction maps, derived from the basic prediction, are provided for those unable to make use of an electronic computer. Figures 1 to 12 present world maps of MUF (Zero) F_2 and MUF (4000) F_2 for each even hour of universal time. Figures 13 to 16 present the same predictions for hours 00 and 12 universal time for the North and South Polar areas. Predicted polar maps for each even hour of universal time may be obtained by special arrangements with the Central Radio Propagation Laboratory. Handbook 90 describes methods for including regular E- F_1 propagation. Figure A is a graph of predicted and observed Zürich sunspot numbers which shows the recent trend of solar activity. Table A lists observed and predicted Zürich smoothed relative sunspot numbers and includes the sunspot number used for the current prediction.

Members of the U.S. Army, Navy, or Air Force desiring the Handbook and the Ionospheric Predictions should send requests to the proper service address; for the Navy: The Director, Naval Communications, Department of the Navy, Washington, D.C., 20350; for the Air Force: Directorate of Command Control and Communications, Headquarters, United States Air Force, Washington, D.C., 20330. Attention: AFOCCAA. Army personnel should refer to the Handbook as TM-11-499 and to the monthly predictions as TB 11-499-(), predictions for the month of April 1964 being distributed in January 1964 and designated TB 11-499-(13), and should requisition these through normal publication channels.

Information concerning the theory of radio wave propagation and such important problems as absorption, field intensity, lowest useful high frequencies, etc., is given in National Bureau of Standards Circular 462, "Ionospheric Radio Propagation." A revised work is in preparation which will be announced in the Ionospheric Prediction series when available. Additional information about radio noise may be found in C.C.I.R. Report Number 65, "Revision of Atmospheric Noise Data," International Telecommunication Union, Geneva, 1957.

Reports to this Laboratory of experience with these predictions would be appreciated. Correspondence should be addressed to the Prediction Services Section, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado.

Table A

Observed and Predicted Zurich Smoothed Relative
Sunspot Numbers

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1952	43 (53)	42 (51)	39 (52)	36 (52)	34 (52)	32 (52)	31 (51)	29 (49)	28 (46)	28 (43)	27 (38)	26 (33)
1953	24 (30)	22 (29)	20 (27)	19 (24)	17 (22)	15 (21)	13 (20)	12 (18)	11 (18)	10 (17)	9 (16)	7 (15)
1954	6 (14)	6 (12)	4 (11)	3 (10)	4 (10)	4 (9)	5 (8)	7 (8)	8 (8)	8 (10)	10 (10)	12 (11)
1955	14 (12)	16 (14)	20 (14)	23 (13)	29 (16)	35 (18)	40 (22)	46 (27)	55 (30)	64 (31)	73 (35)	81 (42)
1956	89 (48)	98 (53)	109 (60)	119 (68)	127 (77)	137 (89)	146 (95)	150 (105)	151 (119)	156 (135)	160 (147)	164 (150)
1957	170 (150)	172 (150)	174 (150)	181 (150)	186 (150)	188 (150)	191 (150)	194 (150)	197 (150)	200 (150)	201 (150)	200 (150)
1958	199 (150)	201 (150)	201 (150)	197 (150)	191 (150)	187 (150)	185 (150)	185 (150)	184 (150)	182 (150)	181 (150)	180 (150)
1959	179 (150)	177 (150)	174 (150)	169 (150)	165 (146)	161 (143)	156 (141)	151 (142)	146 (141)	141 (139)	137 (137)	132 (137)
1960	129 (136)	125 (135)	122 (133)	120 (130)	117 (125)	114 (120)	109 (118)	102 (115)	98 (110)	93 (108)	88 (105)	84 (100)
1961	80 (100)	75 (90)	69 (90)	64 (90)	60 (85)	56 (85)	53 (80)	52 (75)	52 (70)	51 (70)	50 (65)	49 (60)
1962	45 (60)	42 (50)	40 (48)	39 (45)	39 (42)	38 (37)	36 (34)	34 (31)	32 (29)	31 (28)	30 (27)	30 (34)
1963	29 (31)	30 (28)	30 (26)	29 (25)	(25)	(25)	(23)	(21)	(20)	(18)	(18)	(17)
1964	(17)	(17)	(17)	(17)*								

Note: Final numbers are listed through June 1962, the succeeding values being based on provisional data. The predicted numbers are in parentheses.

* Number used for predictions in this issue.

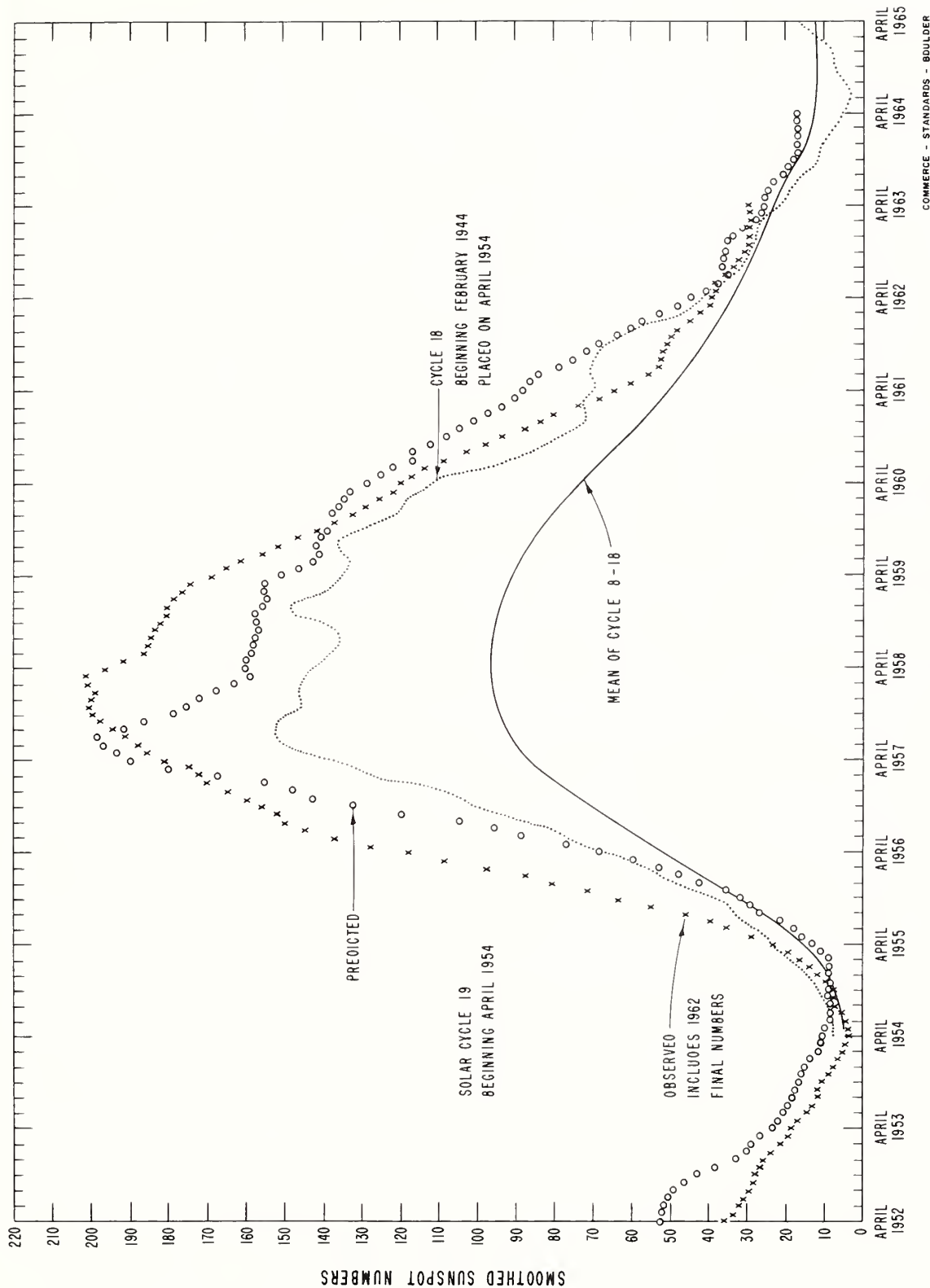


FIG. A. PREDICTED AND OBSERVED SUNSPOT NUMBERS

TABLE I
TIME VARIATION

Harmonic	0		1		2		3		4		5		6		7		8	
	K	S	K	S	K	S	K	S	K	S	K	S	K	S	K	S	K	S
I	0	7.437459E 00	2.2963862E 00	1.8566117C 00	-5.6.195561E-01	3.1444134F-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	2.6993137E-01	-1.2198459E-01	-2.6993137E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-2.6993137E-01	-1.2198459E-01
	1	7.6851946E-02	-3.2295496E-01	2.2550043C 01	3.61348513E-01	-3.61348513E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01
	2	-7.3012986E 00	4.977733E-01	1.9703198C 01	-3.61348513E-01	-3.61348513E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01
	3	1.19383724E 01	3.65711253E 01	4.7720528C 01	-3.61348513E-01	-3.61348513E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01
	4	1.9330608E 00	-7.77947915E 01	-4.7777963C 01	-3.61348513E-01	-3.61348513E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01
	5	-1.1921731E 02	2.62681970E 02	4.8864182E 02	1.10790613E 02	1.10790613E 02	3.5747926F 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	6	2.6703116E 02	5.3550000E 02	5.3550000E 02	1.10790613E 02	1.10790613E 02	3.5747926F 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	7	-1.4261339E 02	-4.4847476E 02	-5.2602765E 02	-1.6028399E 02	-1.6028399E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	8	-1.4261339E 02	-4.4847476E 02	-5.2602765E 02	-1.6028399E 02	-1.6028399E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	9	-1.4261339E 02	-4.4847476E 02	-5.2602765E 02	-1.6028399E 02	-1.6028399E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	10	1.4162582E 02	3.8837117E 02	4.5770345E 02	-0.95612326E 00	-0.95612326E 00	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	11	7.4526151E 01	4.9399058E 02	2.0226655E 01	7.0982234E 01	7.0982234E 01	-2.7143043F 01	1.4663719C 01	1.4663719C 01	3.43154479E 01	1.10908870E 01	3.57514511E 01	3.57514511E 01	1.10908870E 01	3.43154479E 01	1.4663719C 01	7.0982234E 01	4.9399058E 02
12	-4.51727184E 01	1.29447386E 02	-1.3703116C 02	1.10900035E 01	1.10900035E 01	3.50549594E 01	3.50549594E 01	1.121259E 00	-1.121259E 00	-8.2523292E 00	-8.2523292E 00	-1.121259E 00	-8.2523292E 00	-1.121259E 00	-8.2523292E 00	-1.121259E 00	-8.2523292E 00	
II	14	1.4830226E-01	1.0781779E-01	2.4441424F-01	9.25567011C-02	-4.27750145E-02	-9.0778099E-02	1.1927616F-01	1.1927616F-01	9.25567011C-02	-4.27750145E-02	-9.0778099E-02	1.1927616F-01	1.1927616F-01	9.25567011C-02	-4.27750145E-02	-9.0778099E-02	1.1927616F-01
	15	1.9218949E-01	2.5532264E-01	3.7607149E-01	3.61348513E-01	-3.61348513E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01
	16	2.504258E-02	2.977773E-02	1.9703198C 01	-3.61348513E-01	-3.61348513E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01	-5.527070E-01	-1.0400005E-01	-4.157871E-01
	17	-1.054278E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00	-5.981129E 00
	18	-1.455638E 01	-1.455638E 01	-1.8264094E 01	8.2745406E-01	8.2745406E-01	3.5747926F 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	19	7.9628963E 01	5.3531879E 01	1.3213341E 01	-2.4187479E 00	-2.4187479E 00	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	20	9.2655266E 01	7.7468398E 01	2.3538428E 01	3.8477965E 01	3.8477965E 01	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	21	1.6805316E 01	1.3768606E 02	2.1343963E 02	3.8477965E 01	3.8477965E 01	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	22	7.6545339E 01	1.6094867E 01	3.5781812E 01	4.7991610E 02	4.7991610E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01
	23	-8.0704410E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01	-3.5781812E 01
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	25	-8.8692385E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02
26	-2.8082808E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	-2.8187317E 02	
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28	1.33554427E 03	6.9725942E 02	8.7774591E 02	1.0659028E 04	1.0659028E 04	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
29	1.82181844E 02	9.7876893E 02	4.1268774E 01	1.6513202E 02	1.6513202E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
30	-2.5975587E 02	-1.2577790E 02	-1.9307856E 03	9.7876893E 02	9.7876893E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
31	1.0436631E 03	-1.3047933E 03	-1.20181184E 03	9.7876893E 02	9.7876893E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
32	-1.2674933E 03	-2.6477933E 03	-1.0507473E 03	9.7876893E 02	9.7876893E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
33	-1.2674933E 03	-2.6477933E 03	-1.0507473E 03	9.7876893E 02	9.7876893E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
34	-1.2674933E 03	-2.6477933E 03	-1.0507473E 03	9.7876893E 02	9.7876893E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
35	1.1313433E 02	6.9045322E 01	3.5458477E 03	9.7876893E 02	9.7876893E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
36	-3.0184624E 02	1.4256246E 02	4.2955552E 01	-1.6467238E 02	-1.6467238E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
37	1.52715524E 02	2.8653095E 02	6.5165901E 02	7.9274824E 02	7.9274824E 02	7.5101334C 02	-9.5465779F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	-3.40056893E 01	-5.6232359F 00	-9.5465779F 00	3.40056893E 01	
III	39	0.0575200E-02	-1.0695345E-01	1.3764172E-04	2.0101239E-03	2.0101239E-03	1.3825845E-02	-5.7963134E-02	-5.7963134E-02	1.3825845E-02	-5.7963134E-02	-5.7963134E-02	1.3825845E-02	-5.7963134E-02	-5.7963134E-02	1.3825845E-02	-5.7963134E-02	-5.7963134E-02
	40	1.16470117E-01	1.5986515E-01	2.271														

GEOGRAPHICAL
VARIATION

Harmonic	6															
	9	10	11	12	13	14	15	16								
I	0	1.116542E-01	2.0470436E-01	-1.1464975E-01	3.0709710E-02	-6.8482924E-02	-1.0151203E-01	7.1259313E-02	-1.656872E-02							
	1	-1.9720817E-01	-9.0393118E-03	-4.8163983E-02	-1.3567770E-01	1.1347640E-01	9.680247E-01	2.4206287E-02	9.384267E-02							
	2	1.0000000E-01	0.0000000E+00	0.0000000E+00	-3.3668497E-01	-1.1746906E-01	-6.6358476E-02	-1.411964E-01	8.7738501E-03							
	3	8.0019015E-02	-1.1116592E-02	5.4747595E-02	1.7844475E-02	-1.1510221E-01	-1.3006957E-01	-1.0714463E-01	6.7670531E-02							
	4	1.8344388E-01	3.0704782E-01													

I - Main latitudinal variation; II - First order in longitude, III - Second order in longitude
Notation: For each entry the number given by the first eight digits and sign is multiplied by the power of ten defined by the last two digits and sign.

PREDICTED COEFFICIENTS D_{sk} DEFINING THE FUNCTION $\Gamma(\lambda, \theta, \uparrow)$ FOR MONTHLY MEDIAN $f_o F2$ (Mc/s)

APRIL 1964

GEOGRAPHICAL VARIATION

33	-1.2162455E 03	-6.6267193E 02	1.2018123E 02	4.6340820E 02	8.7170641E 02	-3.5677596E 01	-4.3467053E 01
34	-4.4221737E 02	-1.8067473E 03	-1.4669719E 01	-2.6615737E 01	-1.6111201E 01	-1.5175312E 01	-9.7136093E 01
35	1.1313643E 02	6.0493922E 01	6.494397E 02	5.0502562E 01	-1.2839535E 01	-1.7170789E 01	7.0277050E 01
36	5.0781234E 02	3.3524064E 02	4.9255585E 02	1.0553031E 02	1.9791386E 01	8.5270898E 00	7.0727050E 01
37	1.4325072E 02	1.6467238E 02	1.5548435E 02	1.0516340E 02	3.3210383E 02	3.3748260E 01	1.81464667E 01
38	1.5271524E 02	2.8653095E 02	6.515901E 02	7.9274824E 00	1.1883122E 01	1.1530239E 01	2.4592253E 01
39	-5.0705920E-02	-1.06095345E-01	1.3742172E-04	2.0101239E-03	1.3825845E-02	1.5816068E-02	3.7678548E-02
40	1.1447117E-01	1.59865116E-01	-2.97197507E-01	1.46555431E-01	-5.4367576E-02	-4.9374661E-02	3.3897536E-02
41	7.6140256E-01	1.98427151E-01	1.1754842E-01	-1.7834866E-01	5.7649621E-02	-2.2808272E-02	-1.3166600E-01
42	1.0469696E-01	-3.1768730E-01	-2.5349289E-02	3.98427710E-01	2.2418986E-01	-1.914318E-02	-8.1914318E-02
43	-3.6503941E-01	3.3084856E 00	3.3270971E-02	5.9817308E-01	-1.4345537E-02	7.9956924E-02	-1.914318E-02
44	-1.3525072E-01	-3.0042920E-01	1.2925959E-01	-3.3725959E-01	1.1801190E-01	-1.8292064E-01	-1.8292064E-01
45	-1.4370164E 00	3.0034202E 00	-1.0503111E 00	9.2001575E 00	3.0034202E 00	1.2970556E 00	1.2970556E 00
46	9.64433952E-02	9.64433952E-02	4.82844707E-02	2.0721239E-03	7.0889543E-04	9.7642453E-01	9.7642453E-01
47	-1.1636178E 01	3.38367598E-02	-2.2888141E 00	6.9787397E-01	-4.2888245E-01	4.3140945E-01	1.7030780E-01
48	2.7130799E-01	-4.64767703E-01	1.0897083E 00	9.1524237E-02	9.2480159E-02	4.03877450E-02	1.43140945E-01
49	2.5993613E 00	1.5303848E 00	-3.4095959E 00	2.0186862E-01	-3.3842295E-01	-2.3952300E-02	3.735863E-02
50	-6.4732452E-01	3.4732452E-01	7.1234429E-03	3.3116091E-02	3.3116091E-02	-1.3211643E 00	-1.2348872E 00
51	1.0951985E 01	1.0951985E 01	-1.1271239E 00	3.5781535E-01	3.5781535E-01	3.659491E-01	3.659491E-01
52							

GEOGRAPHICAL
VARIATION

Harmonic	6															
	9	10	11	12	13	14	15	16								
I	0	1.116542E-01	2.0470436E-01	-1.1464975E-01	3.0709710E-02	-6.8482924E-02	-1.0151203E-01	7.1259313E-02	-1.656872E-02							
	1	-1.9720817E-01	-9.0393118E-03	-4.8163983E-02	-1.3567770E-01	1.1347640E-01	9.860247E-01	2.4206287E-02	9.384267E-02							
	2	1.0361917E-01	1.1165992E-02	-3.3626877E-01	3.3626877E-01	-6.6358476E-02	-4.519948E-01	-1.411964E-01	8.7734501E-03							
	3	8.0019015E-02	-1.1165992E-02	5.4747595E-02	-1.7844475E-02	1.1746490E-01	-6.6358476E-02	1.0719463E-01	-1.0719463E-01							
	4	1.8344388E-01	3.0704782E-01	-1.1464975E-01	1.7844475E-02	-1.1510221E-01	-1.3006957E-01	6.7670531E-02								

I - Main latitudinal variation; II - First order in longitude, III - Second order in longitude
Notation: For each entry the number given by the first eight digits and sign is multiplied by the power of ten defined by the last two digits and sign.

PREDICTED COEFFICIENTS D_{sk} DEFINING THE FUNCTION $\Gamma(\lambda, \theta, \uparrow)$ FOR MONTHLY MEDIAN $f_o F2$ (Mc/s)

APRIL 1964

TIME VARIATION

Harmonic	O		I		2		3		4		5		6	
	K	S	I		2		3		4		5		6	
I	0	2.9849960E 00	-1.4437802E-01	-2.2383676E-01	4.4332476E-02	-1.4509081E-01	4.0825358E-02	-9.4083001E-03	-2.3623885E-01	-2.476087E-02	4.0825358E-02	-9.4083001E-03	-2.3623885E-01	-2.476087E-02
	1	-2.9706136E-01	-1.6975449E-01	-2.2279410E-01	3.6274909E-01	-2.3623885E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	2	2.1688738E 00	1.1046029E 00	2.4606741E 00	-2.2933340E-02	2.4606741E 00	-2.2933340E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	3	1.1979625E 00	6.7675901E-01	9.9962348E-01	0.3010404E 00	1.4502062E 00	1.4502062E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	4	-6.8346441E 00	-2.7241098E-01	-5.7837794E 00	-1.1738000E 00	2.4699053E 00	2.4699053E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	5	2.1360720E 00	-7.6771049E-01	-1.8543144E 00	3.1191010E 00	-1.211129E 00	-1.211129E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	6	7.7167778E 00	3.1171654E 00	5.5346233E 00	-2.3795958E 00	-3.6501072E 00	-3.6501072E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	7	1.8853144E 00	2.8243191E-01	9.9201874E-01	-1.6456535E 00	5.4432277E 00	5.4432277E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	8	-3.0036041E 00	-1.3333601E 00	-1.9609175E 00	-1.2316944E 00	-1.2316944E 00	-1.2316944E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
II	9	-6.9594153E-03	-5.2211776E-04	2.7093548E-02	3.8986295E-02	-5.1531379E-03	-5.1531379E-03	-2.8194239E-03	-1.5689758E-02	-1.5689758E-02	-2.8194239E-03	-1.5689758E-02	-1.5689758E-02	-2.8194239E-03
	10	3.1634972E-02	3.4758652E-02	2.7093548E-02	3.8986295E-02	-5.1531379E-03	-5.1531379E-03	-2.8194239E-03	-1.5689758E-02	-1.5689758E-02	-2.8194239E-03	-1.5689758E-02	-1.5689758E-02	-2.8194239E-03
	11	6.7296088E-02	9.6676737E-02	2.5938995E-01	1.0440404E-02	1.6336244E-01	1.6336244E-01	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	12	-5.5658035E-01	-4.4137225E-01	-9.5904202E-01	1.6336244E-01	1.6336244E-01	1.6336244E-01	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	13	8.0456971E-02	3.0616699E-01	5.1563795E-01	1.706595E 00	1.1706595E 00	1.1706595E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	14	-2.8362007E-01	-5.6952257E-01	3.4017514E-02	1.1706595E 00	1.1706595E 00	1.1706595E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	15	-1.2767499E-01	7.8104359E-01	-9.8929787E-01	3.4017514E-02	1.1706595E 00	1.1706595E 00	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	16	3.7676402E 00	2.5361837E 00	5.4063344E 00	-8.7111522E-01	2.372771E-01	2.372771E-01	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
III	17	-5.8038835E-02	2.1575591E 00	1.5812808E 00	-9.5120733E-02	3.7511681E-02	3.7511681E-02	-2.8194239E-03	-1.5689758E-02	-1.5689758E-02	-2.8194239E-03	-1.5689758E-02	-1.5689758E-02	-2.8194239E-03
	18	7.8574020E-01	2.5085943E 00	1.0392278E 00	-5.0895675E-02	3.7511681E-02	3.7511681E-02	-2.8194239E-03	-1.5689758E-02	-1.5689758E-02	-2.8194239E-03	-1.5689758E-02	-1.5689758E-02	-2.8194239E-03
	19	-2.5145336E-01	-1.8961379E 00	9.926295E-01	1.9739229E-01	-8.3536209E-02	-8.3536209E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	20	-6.5545824E 00	-4.3861629E 00	8.3686893E 00	1.3899100E 00	3.0991713E-01	3.0991713E-01	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	21	8.8772814E-01	-4.4686813E 00	1.4857396E 00	2.8065935E-01	-6.4143451E-02	-6.4143451E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	22	-7.2877388E-01	-4.1068363E 00	2.5851052E 00	7.7756124E-01	5.7272864E-02	5.7272864E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	23	3.2284406E-01	1.1449983E 00	7.4637872E-02	1.0700194E-01	1.9532314E-01	1.9532314E-01	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	24	3.5164496E 00	2.4664404E 00	4.2826554E 00	-6.8223388E-01	1.9532314E-01	1.9532314E-01	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
IV	25	-2.7889533E 00	2.7889533E 00	6.2802306E-01	-3.0271445E-01	2.6817601E-02	2.6817601E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	26	-2.5863987E 02	2.2280363E 00	-1.7333764E 00	-3.8220255E 00	-2.4565865E-02	-2.4565865E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	27	2.1930028E 02	-1.7238026E-02	1.9422917E-03	-1.0016856E-02	-5.8C18336E-04	-5.8C18336E-04	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	28	1.2981173E 03	-8.4827825E-03	2.1468335E-02	-5.0407130E-03	-5.5037150E-04	-5.5037150E-04	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	29	1.3354427E 03	1.2988695E-01	2.10332357E-02	4.5733716E-02	1.6082200E-03	1.6082200E-03	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	30	4.6218144E 02	1.1734936E-02	-1.7341093E-02	7.1842762E-02	8.2266343E-04	8.2266343E-04	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	31	-2.5975587E 02	1.8162049E-02	7.8475018E-02	8.2506096E-02	8.8703760E-03	8.8703760E-03	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	32	-1.3472673E 03	9.7307937E-02	-1.2296588E-01	-8.5827497E-02	-4.3358793E-06	-4.3358793E-06	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
V	33	-1.2162455E 03	2.7659157E-01	3.4940011E-03	-7.5478936E-02	-3.5643470E-03	-3.5643470E-03	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	34	-4.2217377E 02	1.9953676E-02	4.6879343E-03	-5.3118111E-02	-2.6551134E-03	-2.6551134E-03	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	35	1.1315433E 02	3.7672046E 02	3.4451937E-02	-1.2641121E-01	-1.7402920E-02	-1.7402920E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01
	36	5.077234E 02	3.7672046E 02	3.4451937E-02	2.3917882E-01	2.3917882E-01	2.3917882E-01	4.7390788E-02	-9.3641381E-01	-9.3641381E-01	2.2476087E-02	4.7390788E-02	-9.3641381E-01	-9.3641381E-01

GEOGRAPHICAL VARIATION

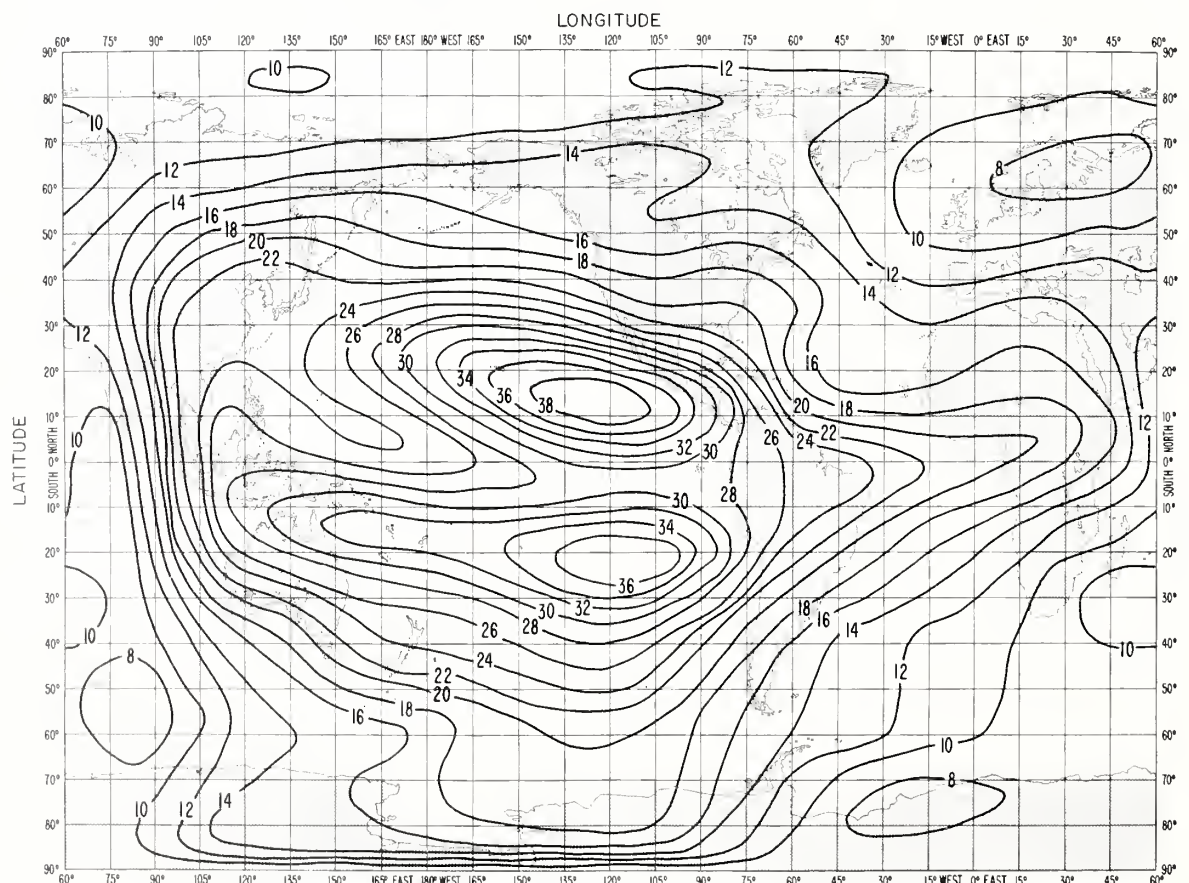
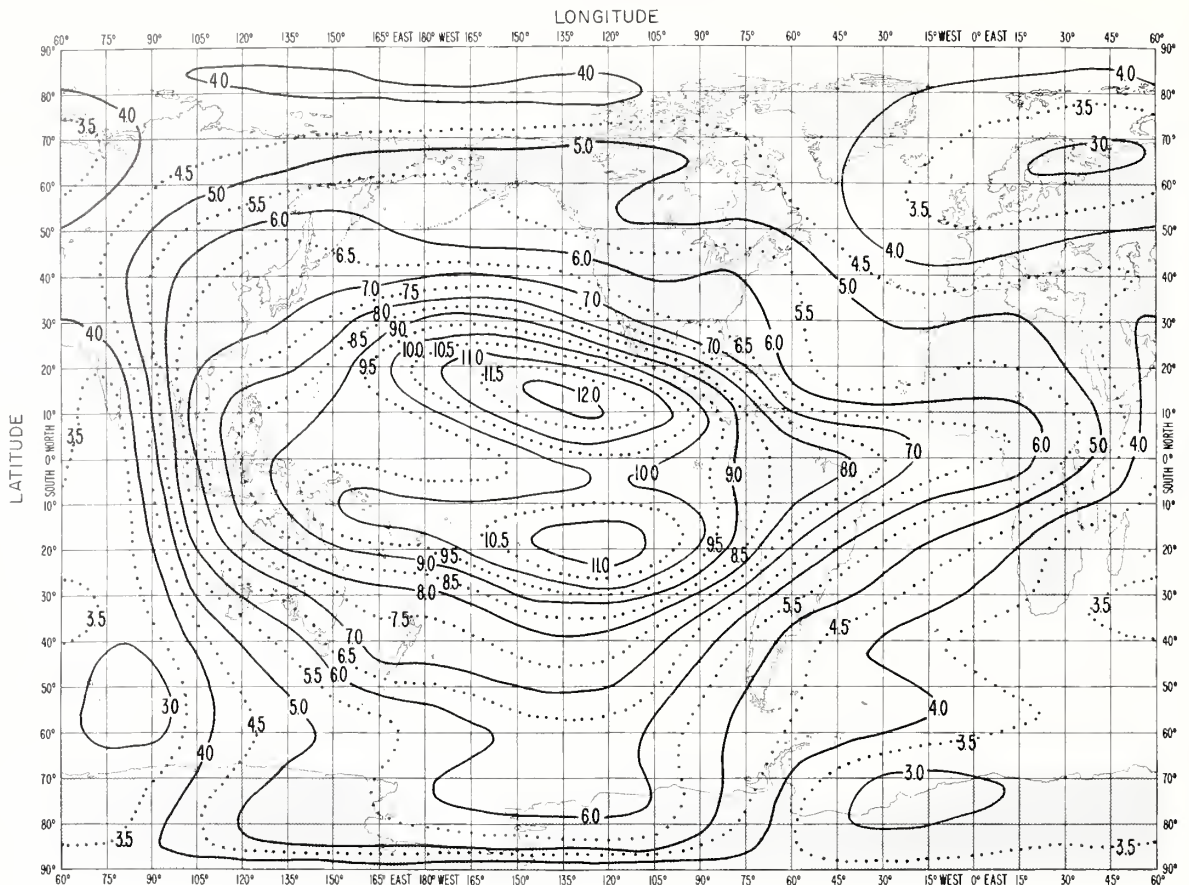
Harmonic	O		I		2		3		4		5		6	
	K	S	I		2		3		4		5		6	
I	0	3.9336434E-02	4.1137517E-03	1.0855319E-02	3.2741035E-02	-1.7586909E-02	-1.2568292E-03	-7.3741248E-03	-3.9427168E-02	-3.2480711E-05	1.5655647E-02	3.6462410E-02	-1.7586909E-02	-1.2568292E-03
	1	6.0863878E-02	3.7213566E-02	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03	-9.0260122E-03
	2	-4.4503254E-02	-2.9563079E-03	-8.5539818E-03	-3.4176681E-03	-3.4176681E-03	-3.4176681E-03	-3.4176681E-03	-3.4176681E-03	-3.4176681E-03	-3.4176681E-03	-3.4176681E-03	-3.4176681E-03	-3.4176681E-03
	3	-7.9142801E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02	-2.2764307E-02

I - Main latitudinal variation. Mixed latitudinal and longitudinal variation: II - First order in longitude, III - Second order in longitude.
 Notation: For each entry the number given by the first eight digits and sign is multiplied by the power of ten defined by the last two digits and sign.

PREDICTED COEFFICIENTS D_{SK} DEFINING THE FUNCTION $I(\lambda, \theta, t)$ FOR MONTHLY MEDIAN $M(3000)F2$

APRIL 1964

Erratum: See page following order form.



APRIL 1964 UT=02

LONGITUDE

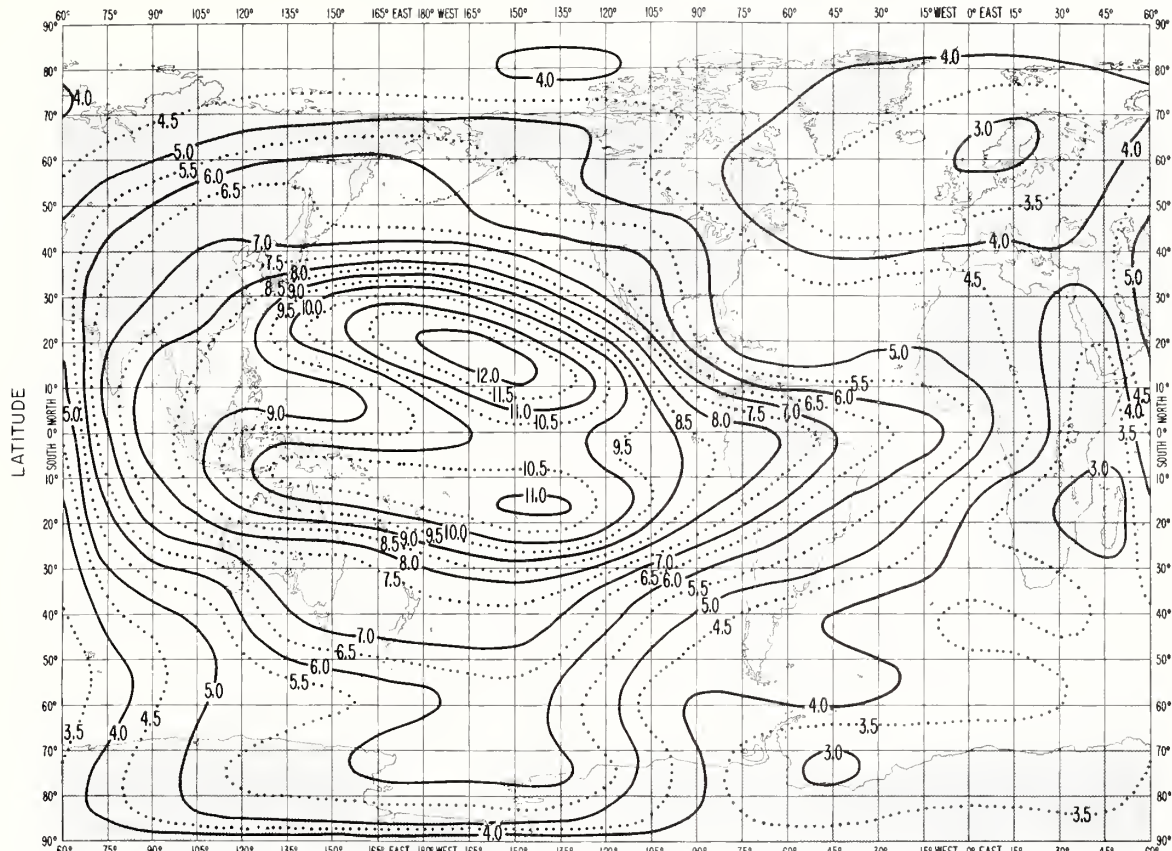


FIG. 2A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

LONGITUDE

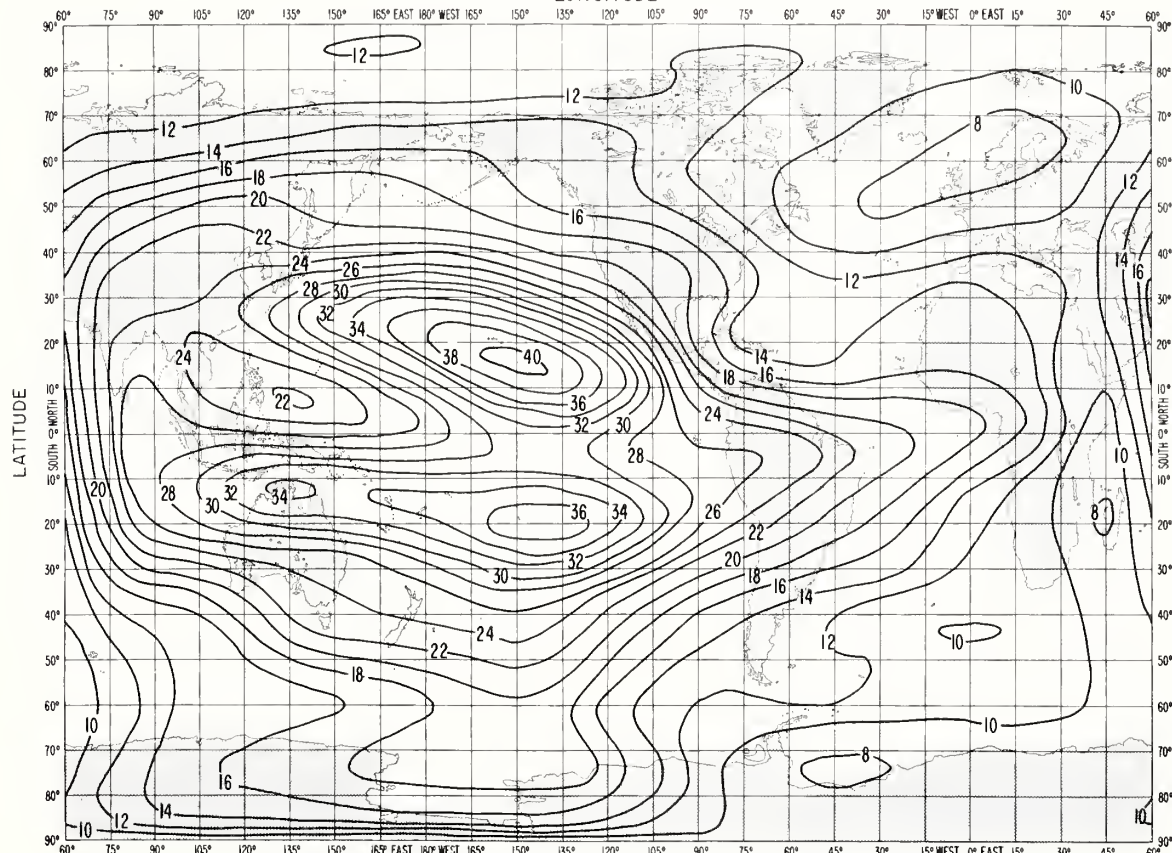


FIG. 2B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

APRIL 1964 UT=04

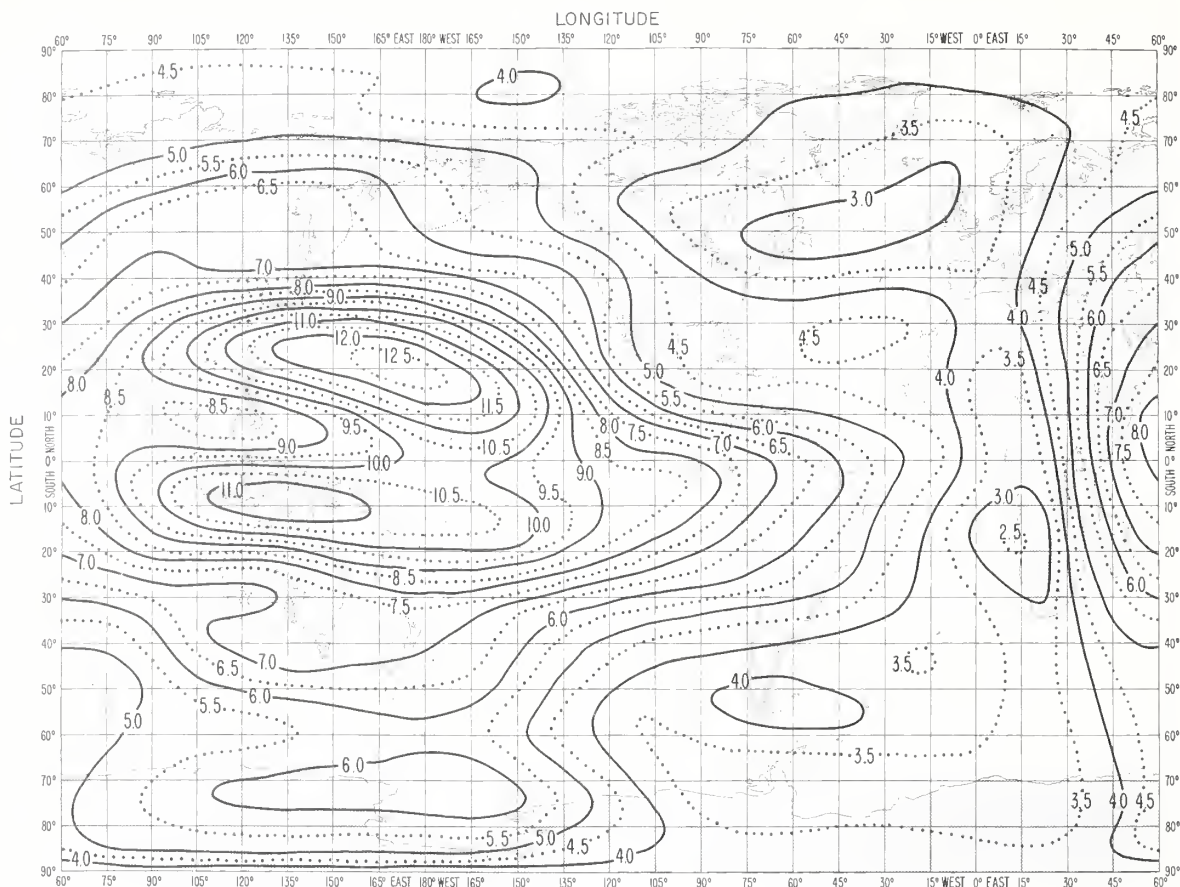


FIG 3A PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

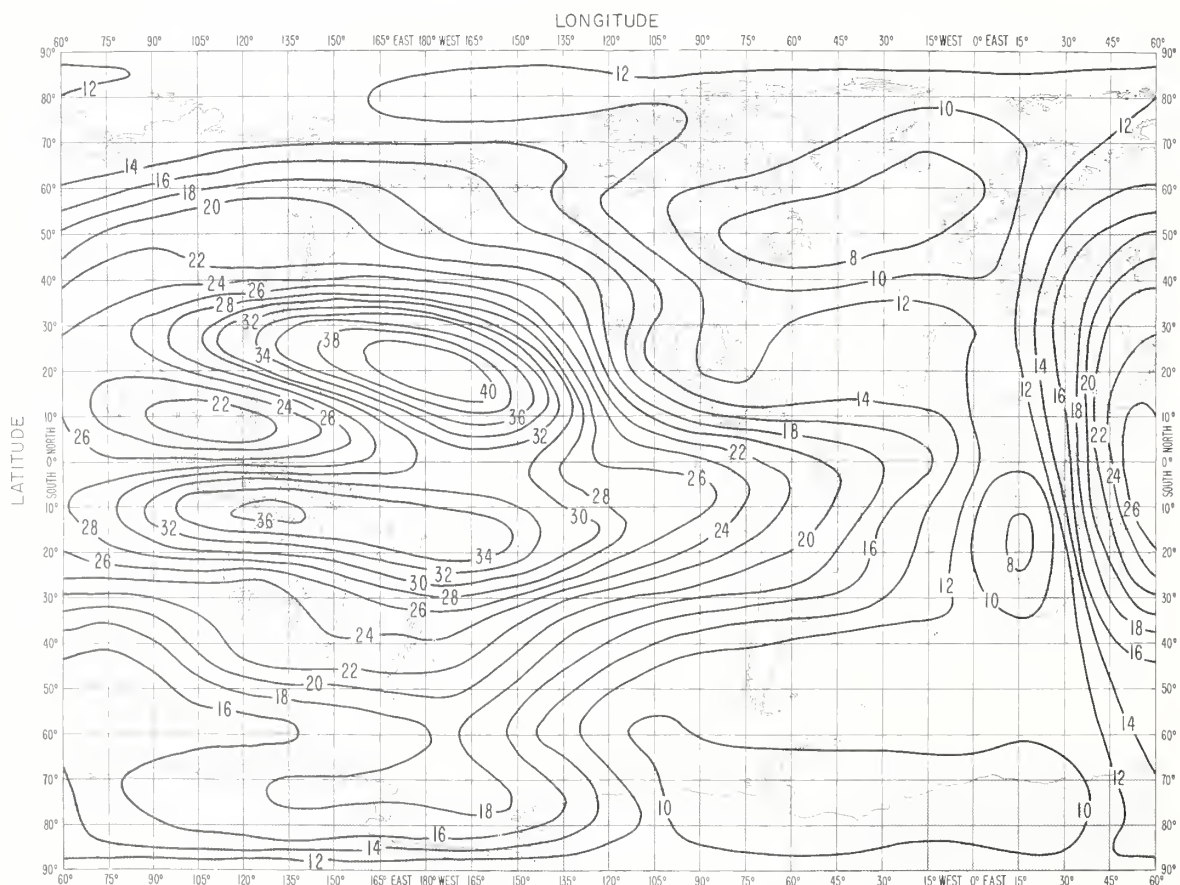
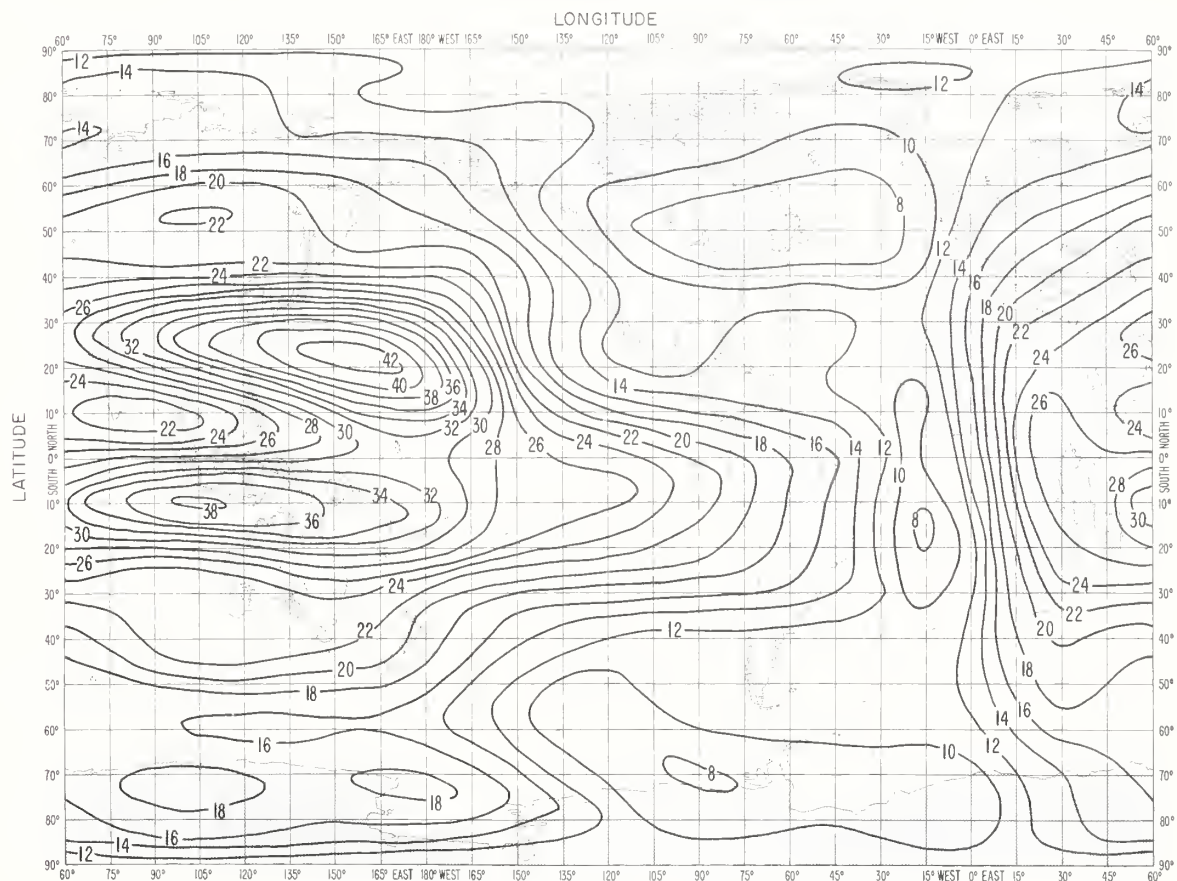
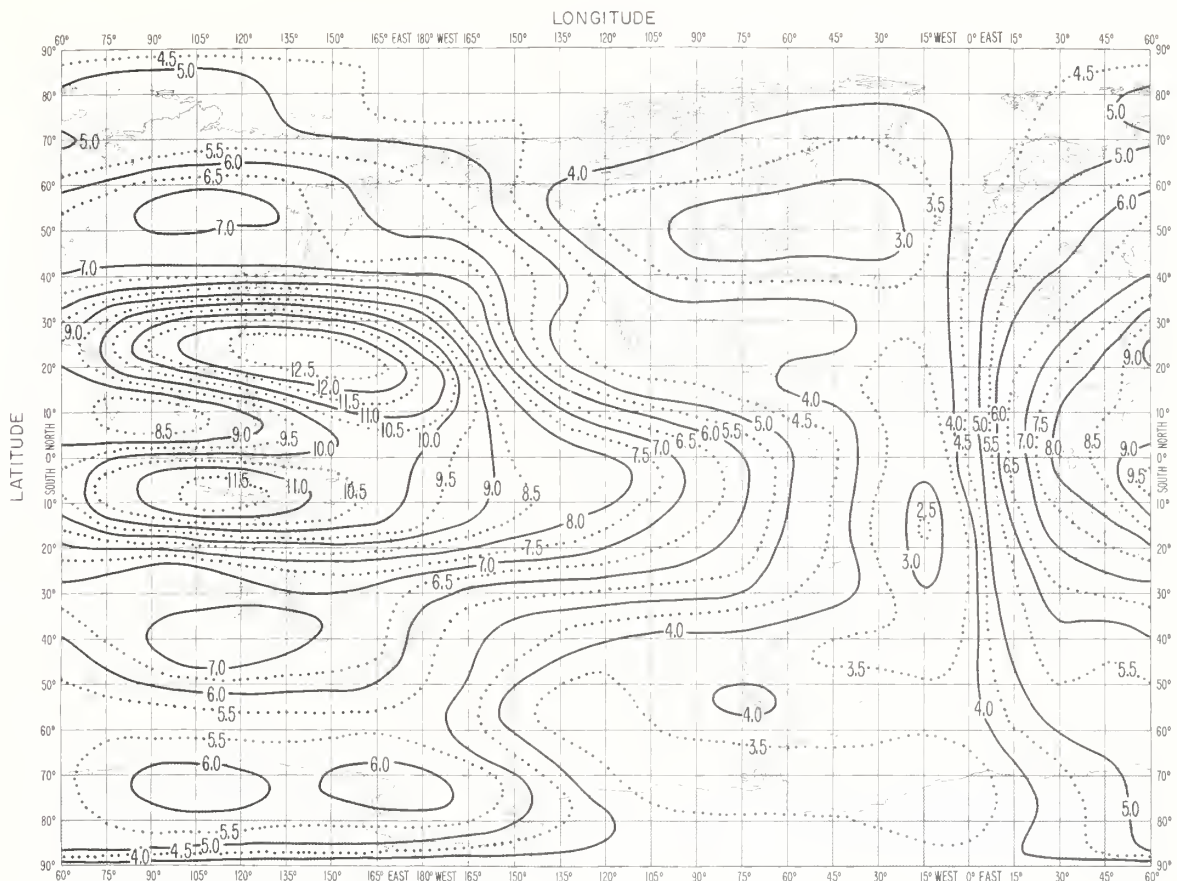


FIG 3B PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

APRIL 1964 UT = 06



APRIL 1964 UT=08

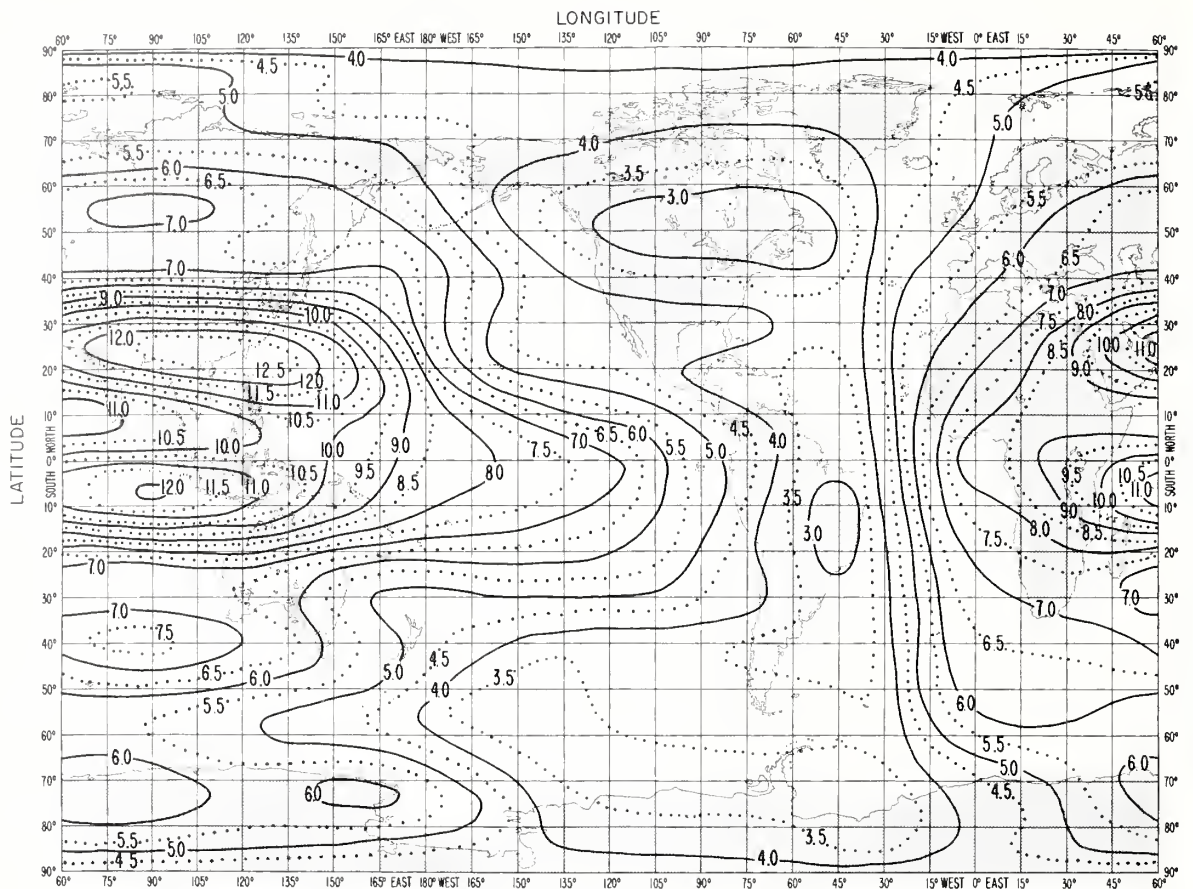


FIG 5A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

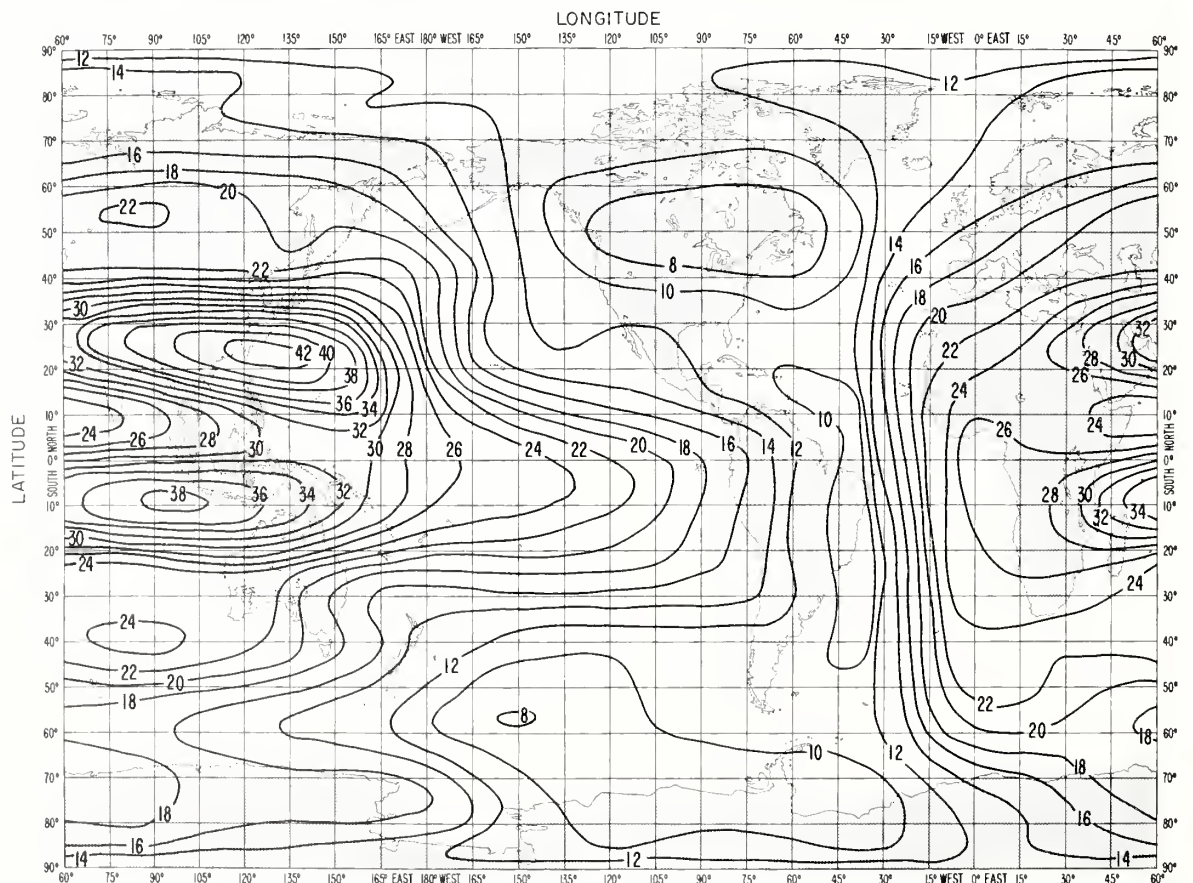


FIG 5B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

APRIL 1964 UT = 10

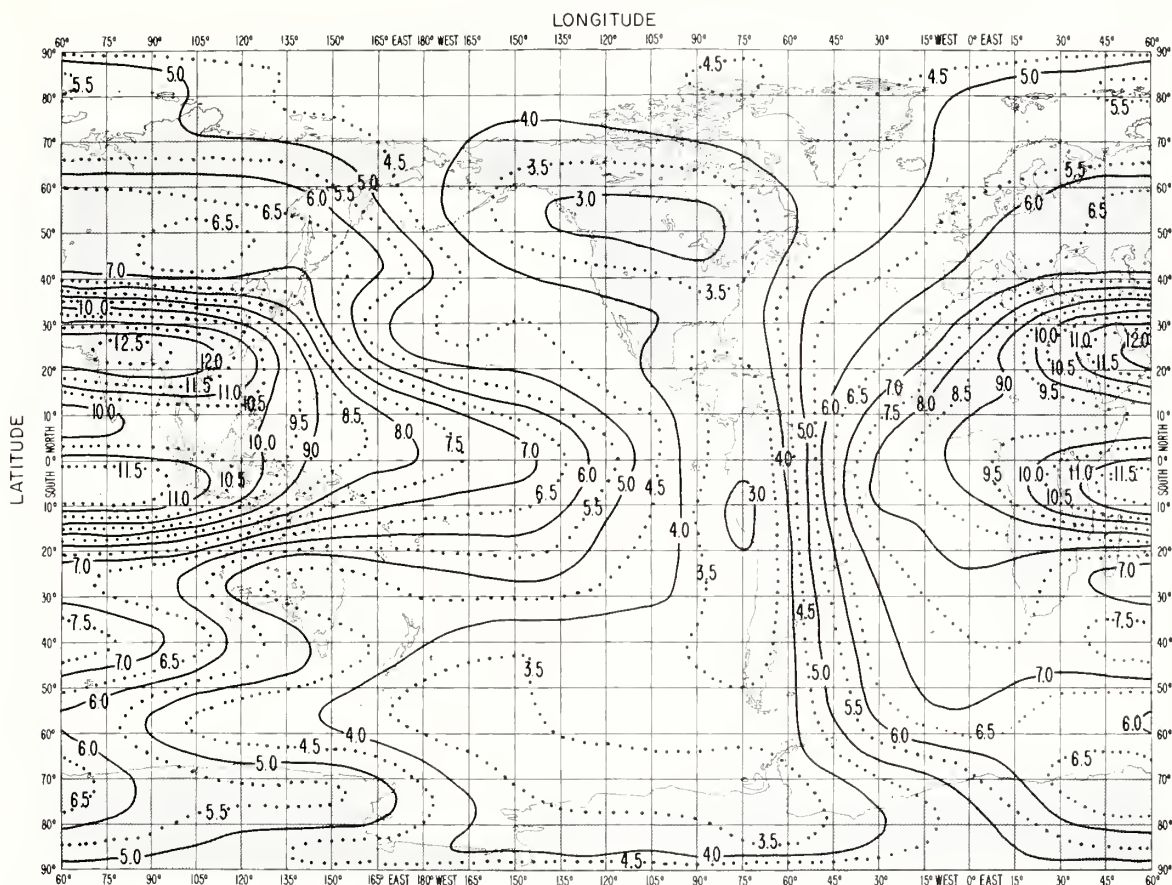


FIG. 6A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

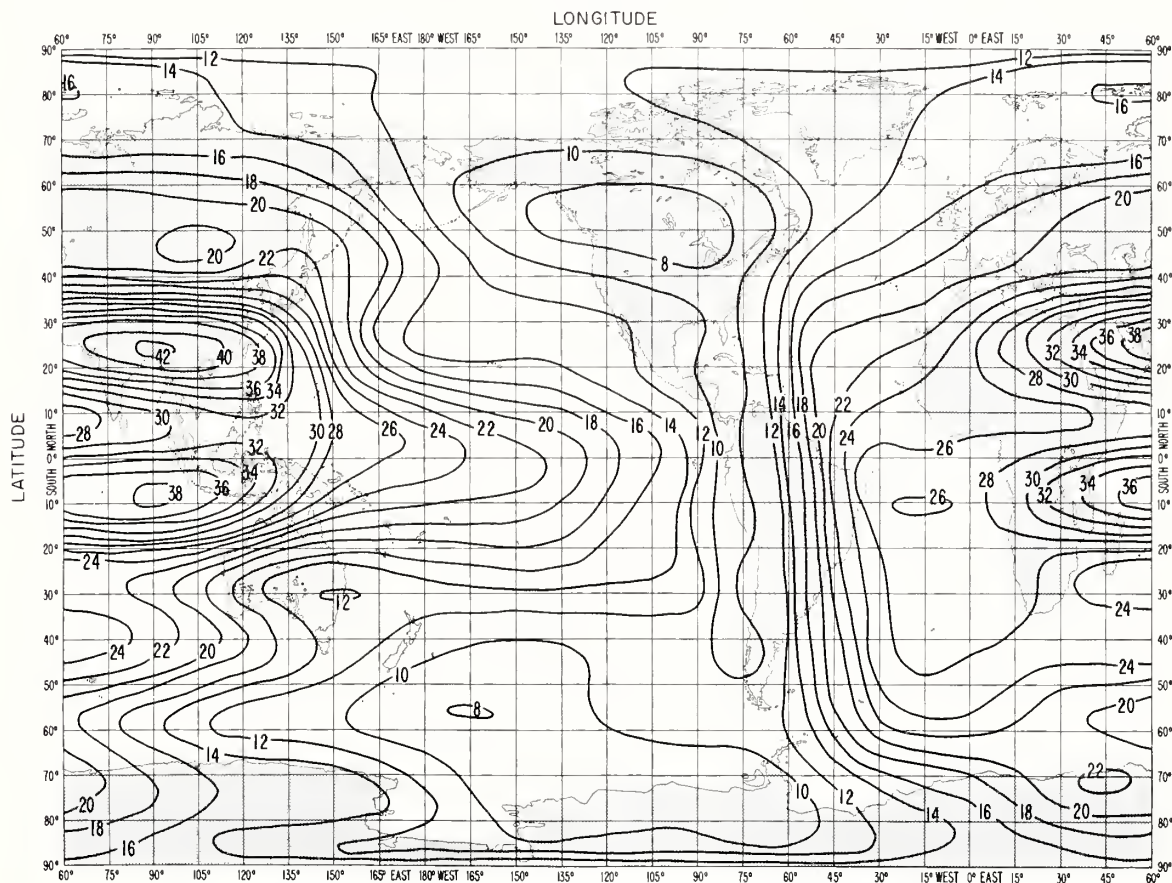
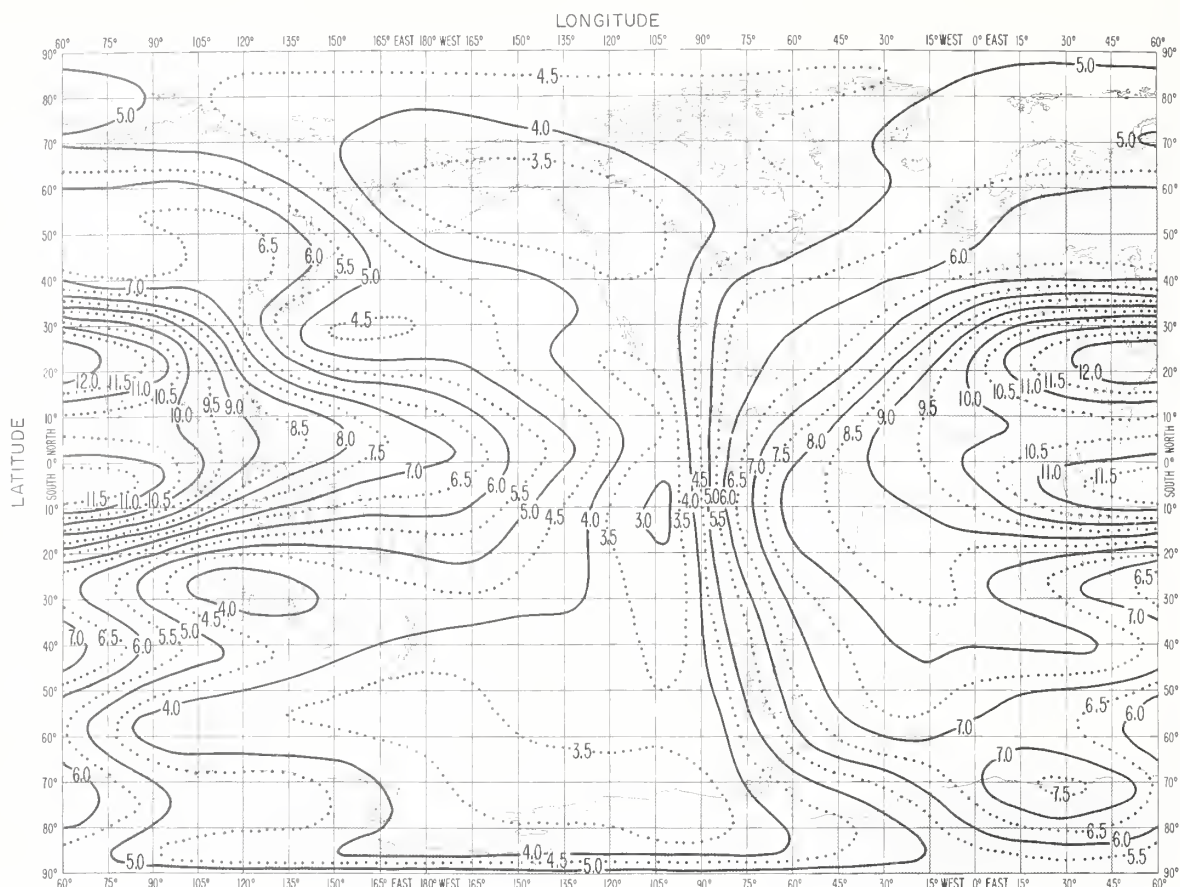
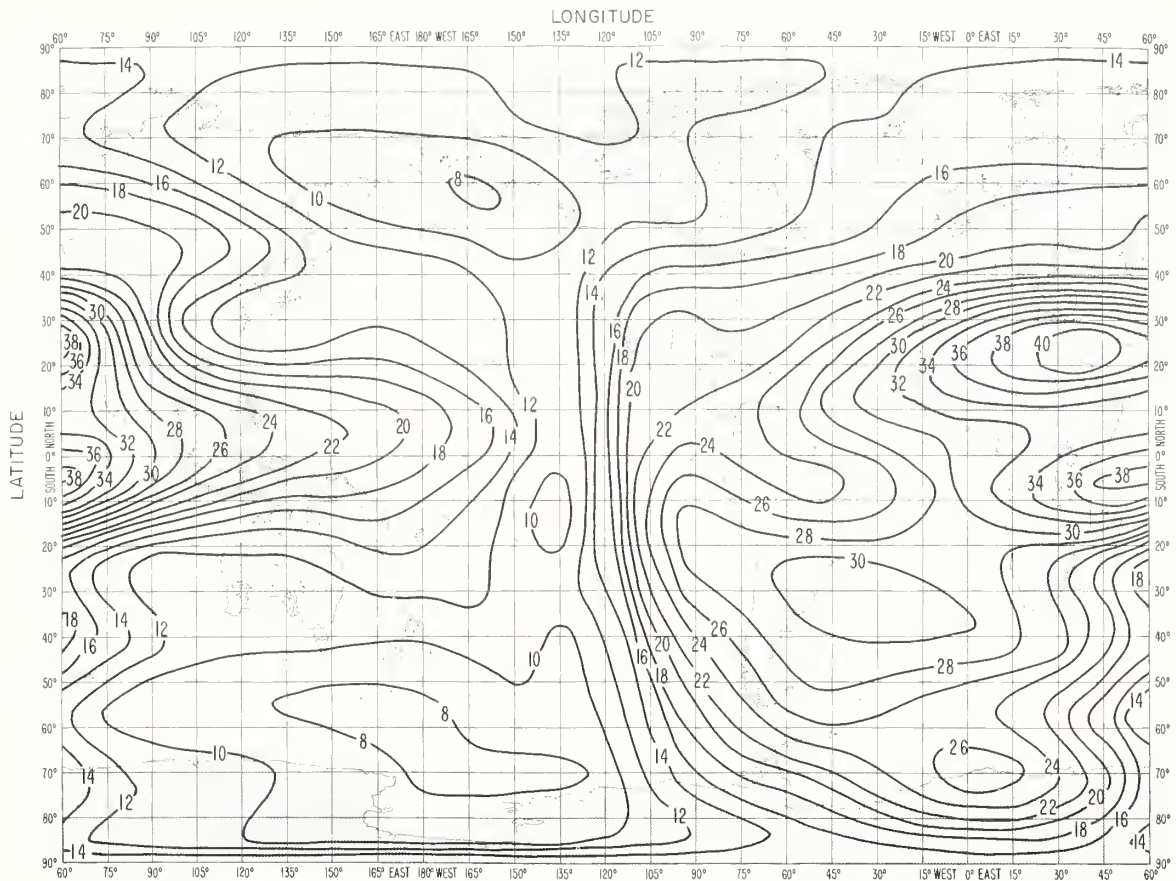
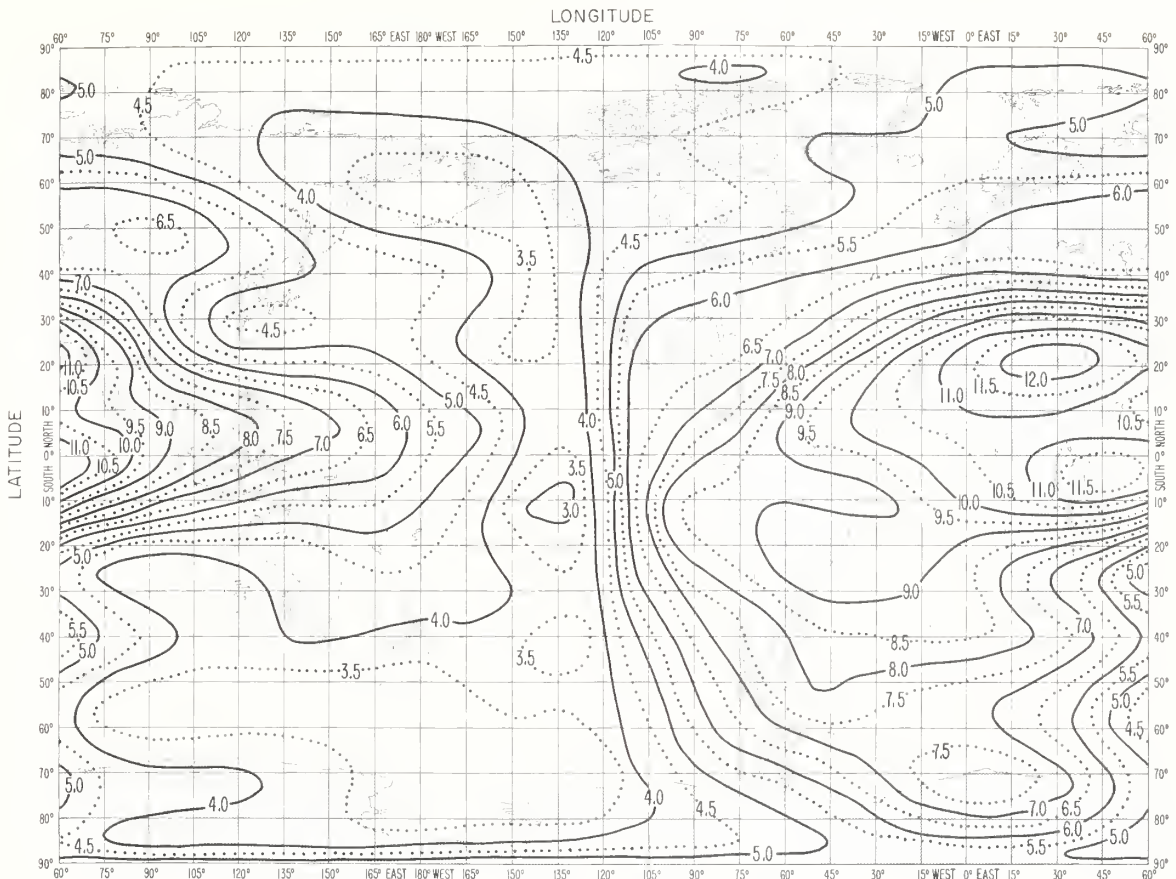


FIG. 6B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)



APRIL 1964 UT = 14



APRIL 1964 UT = 16

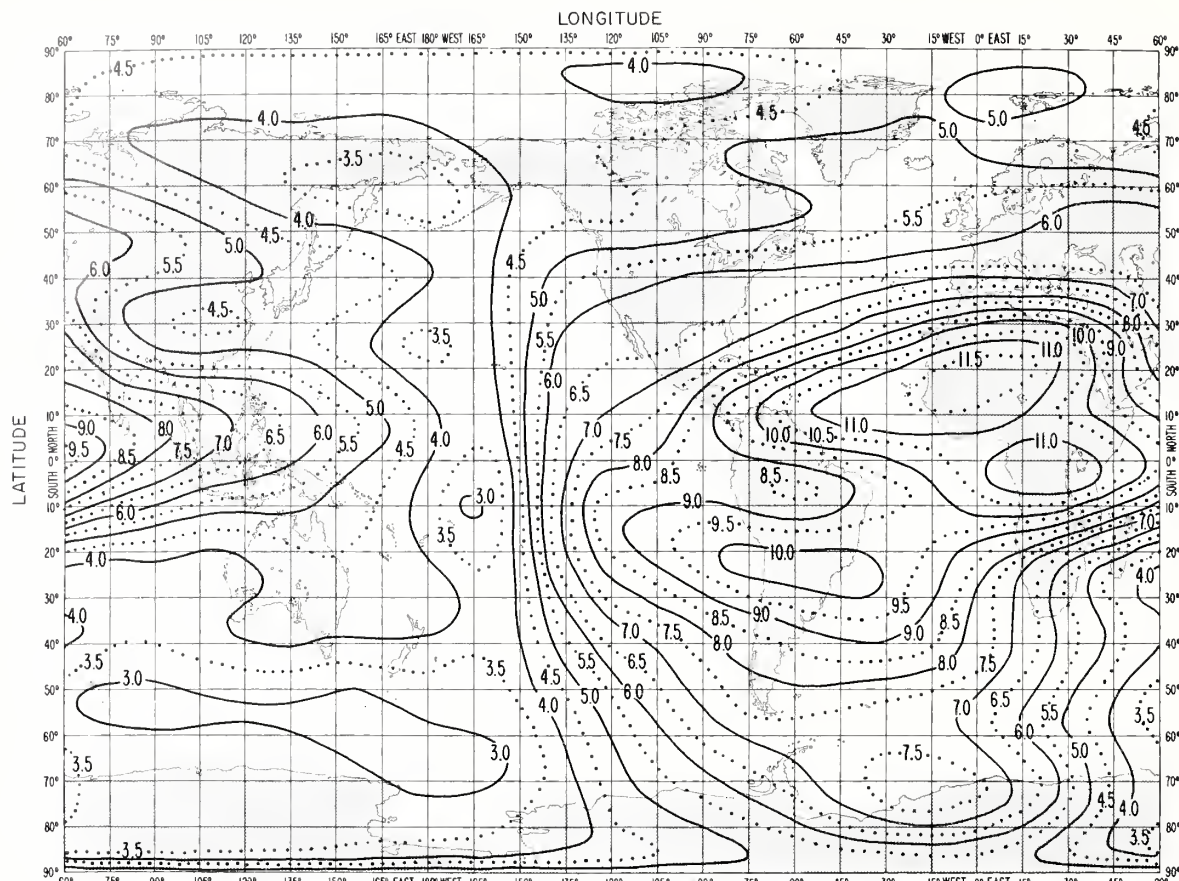


FIG 9 A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

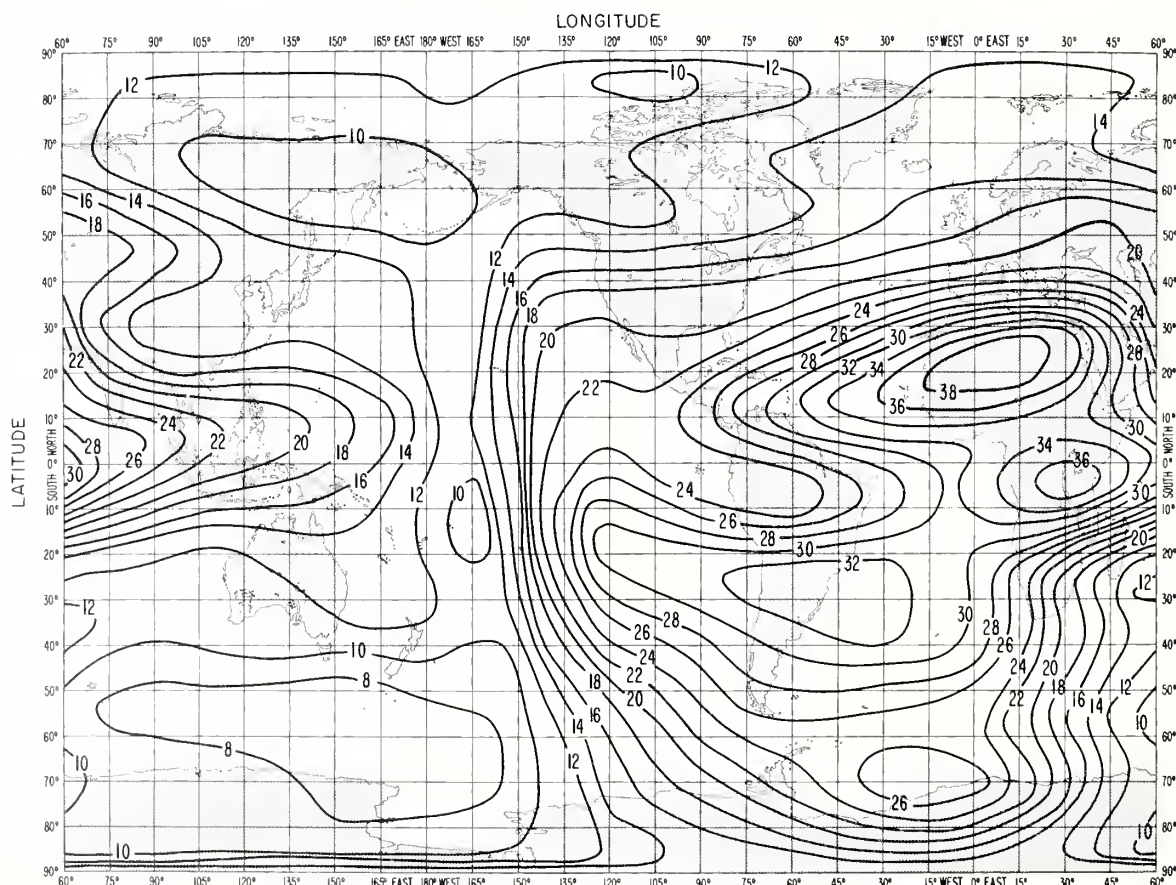


FIG. 9B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

APRIL 1964 UT = 18

LONGITUDE

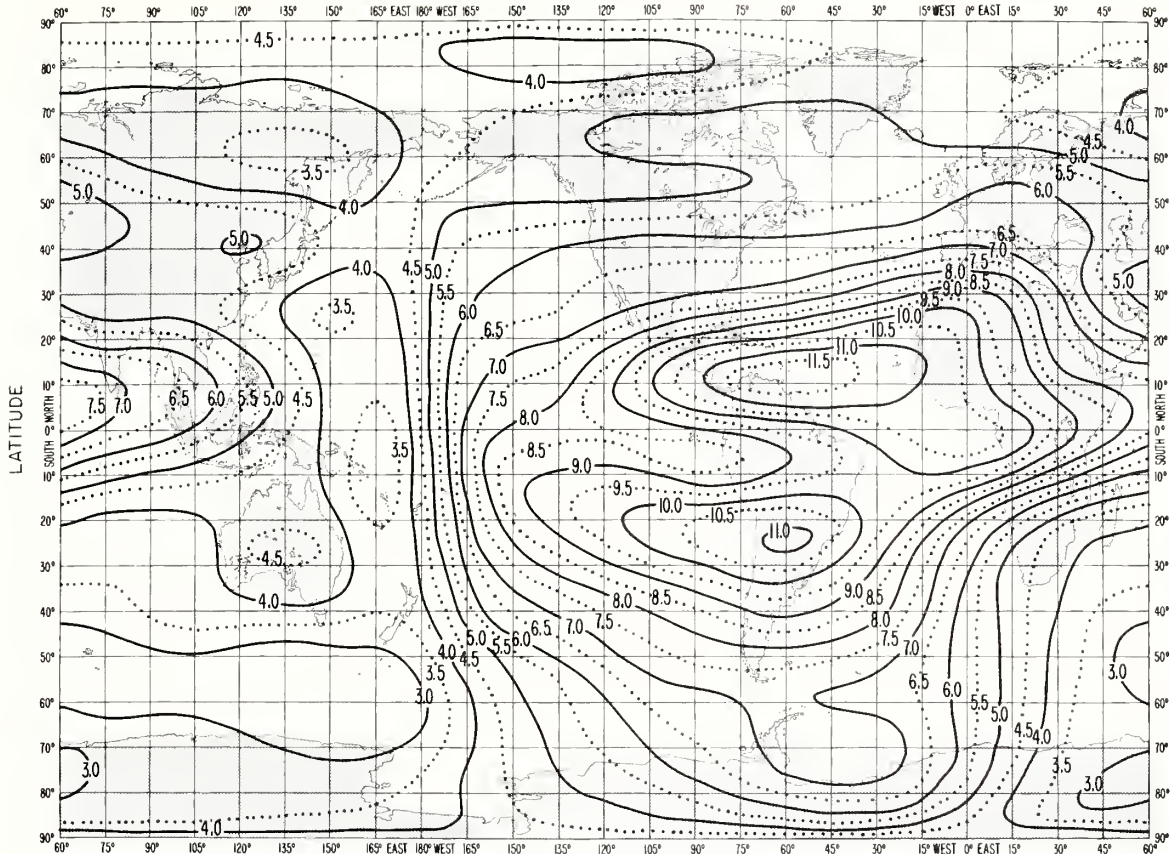


FIG. 10A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

LONGITUDE

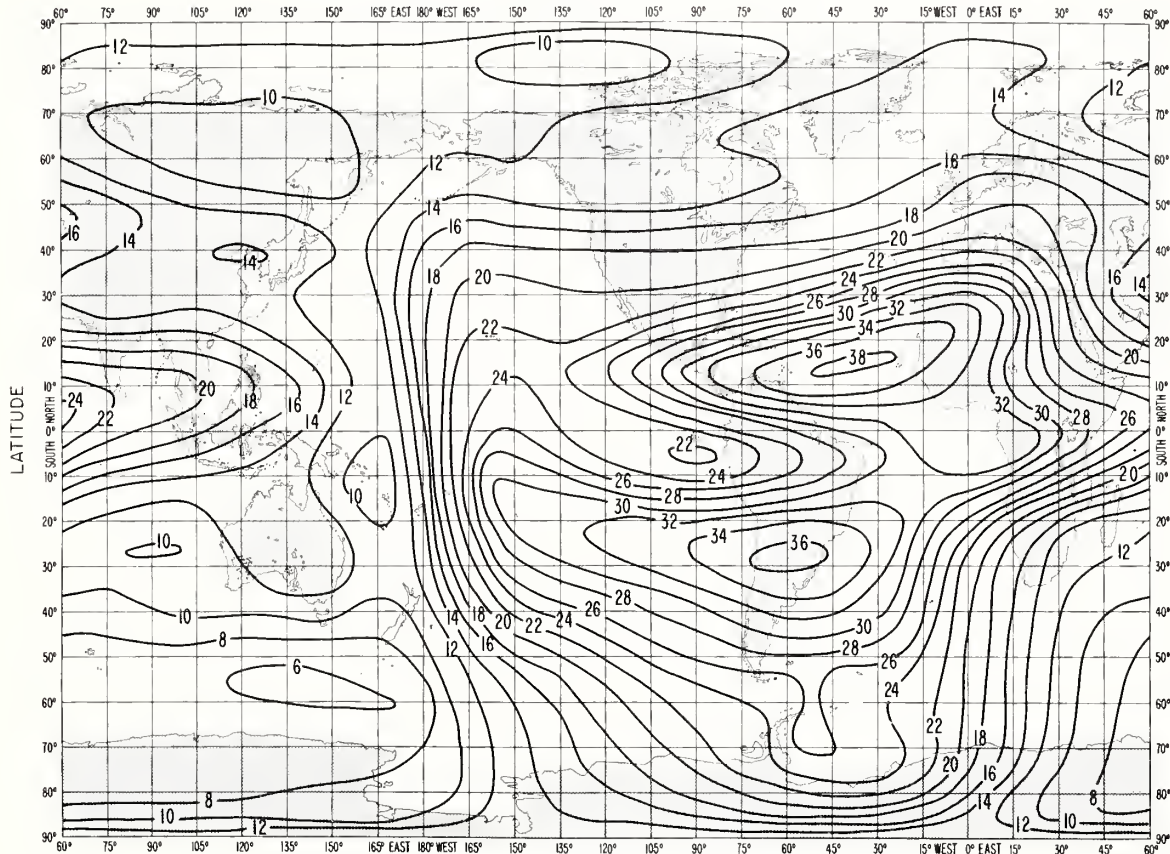


FIG. 10B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

APRIL 1964 UT = 20



FIG IIA. PREDICTED MEDIAN MUF(0)F2 (Mc/s)

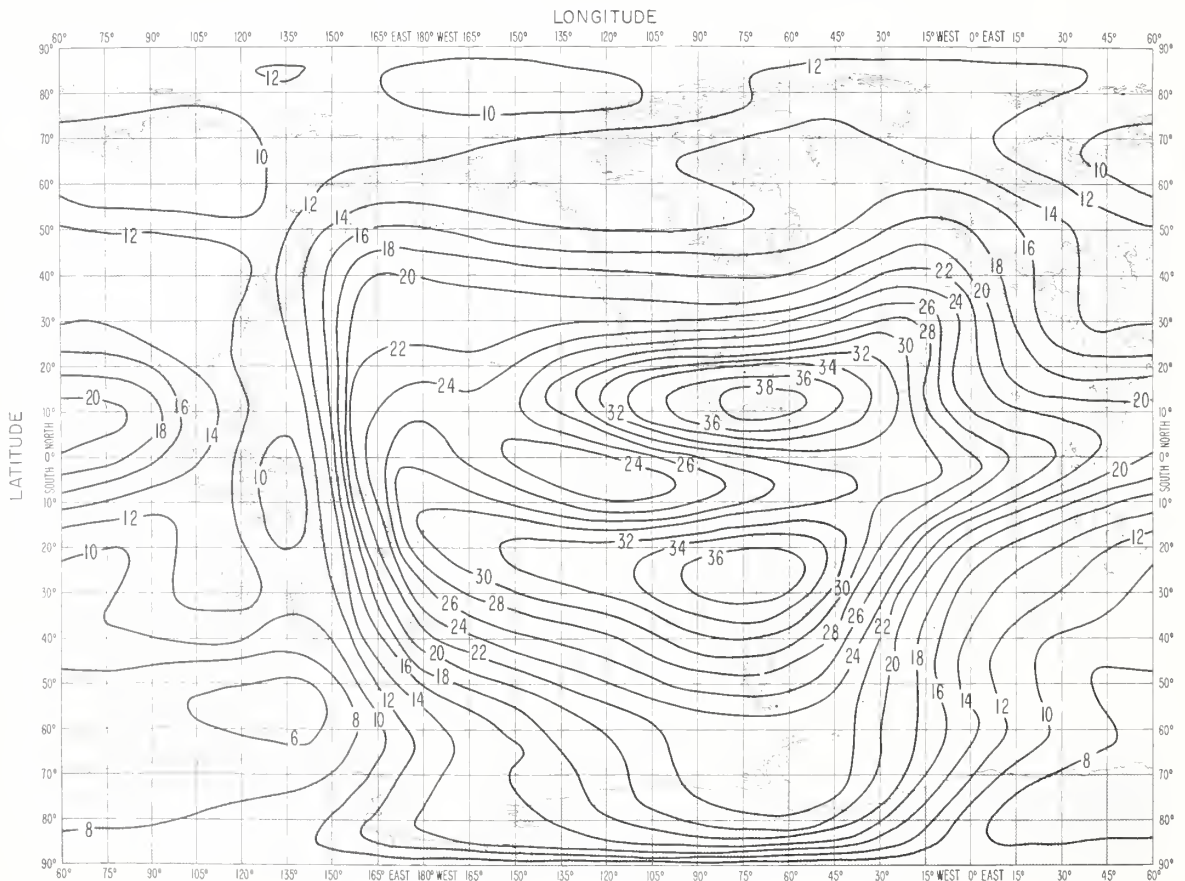


FIG IIB. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

APRIL 1964 UT = 22

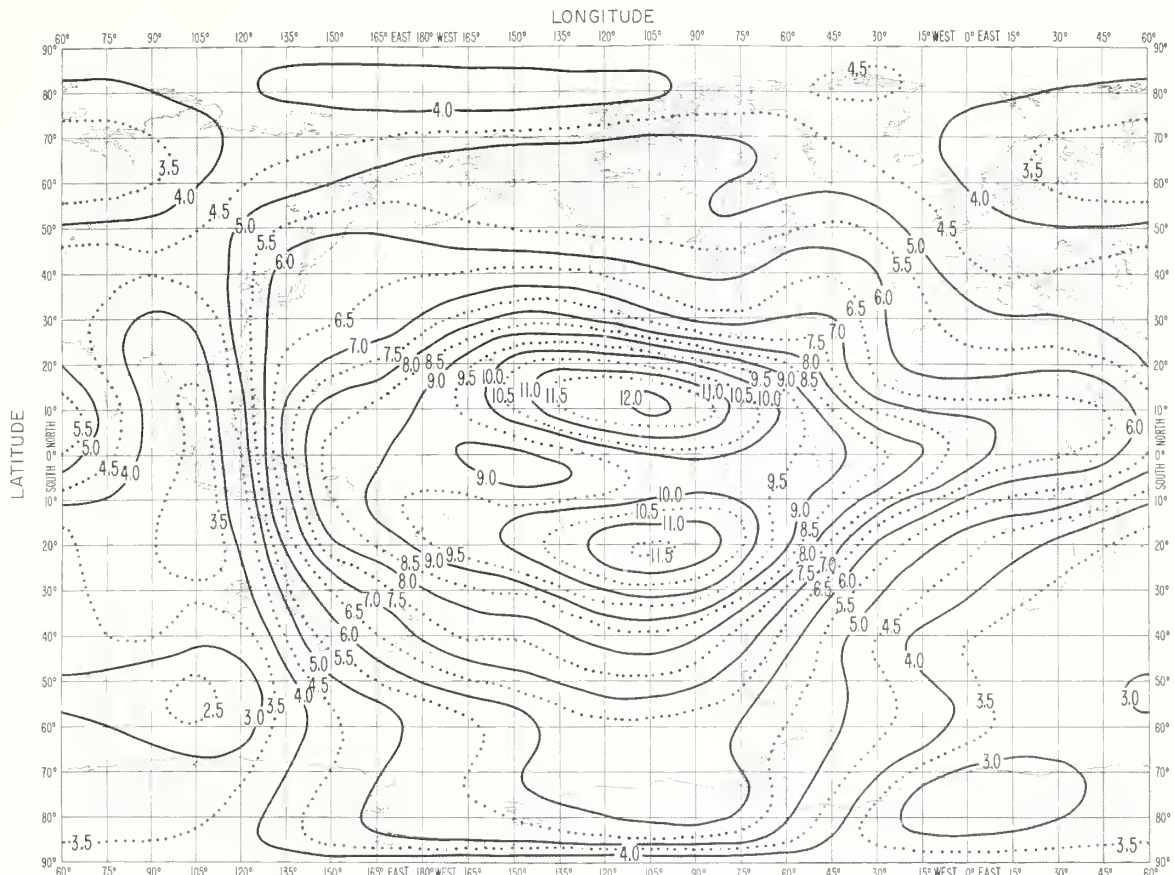


FIG 12A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

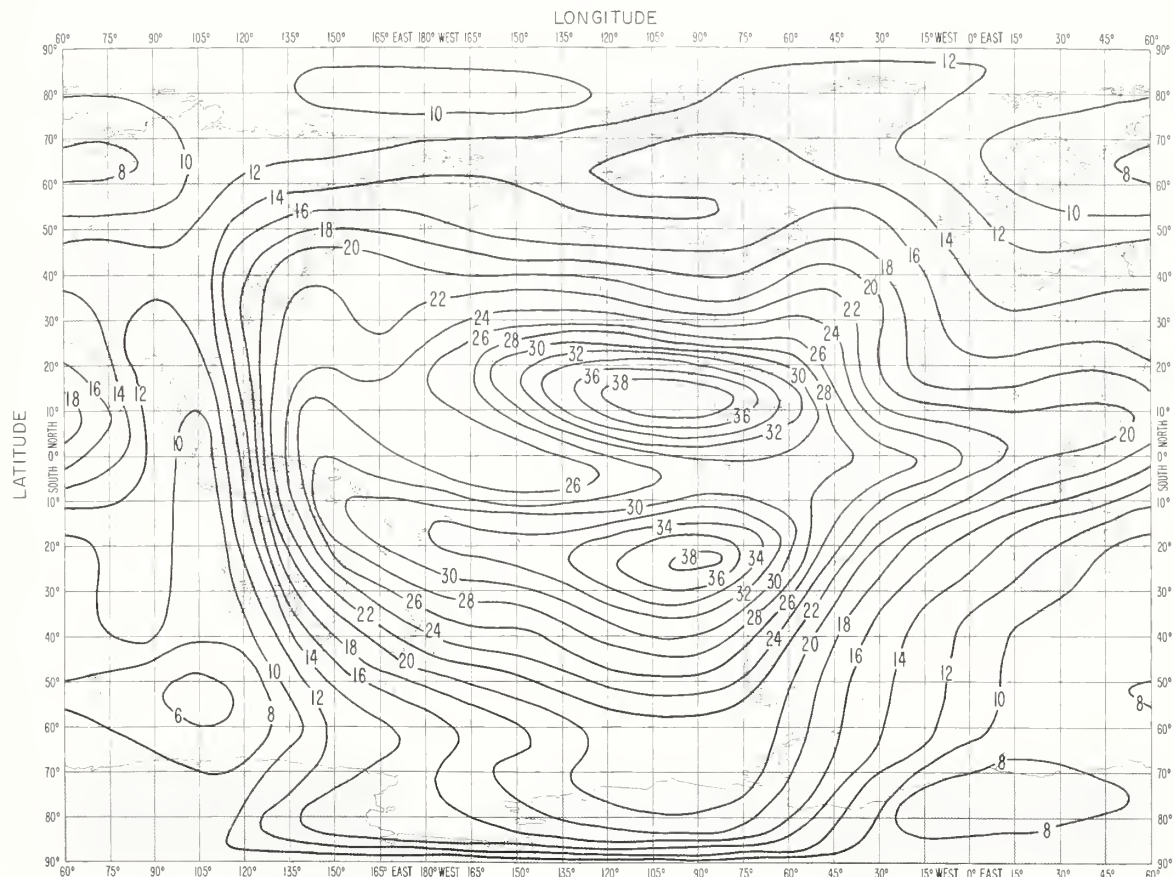


FIG 12B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

NORTH POLAR AREA
APRIL 1964 UT = 00

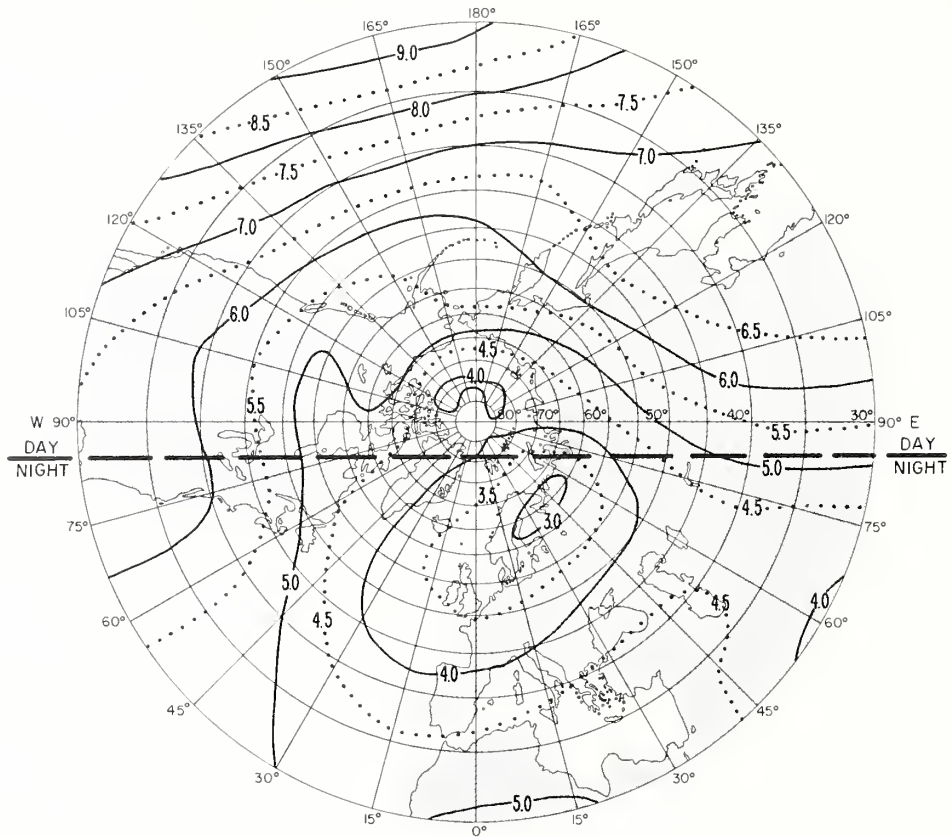


FIG. 13A PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

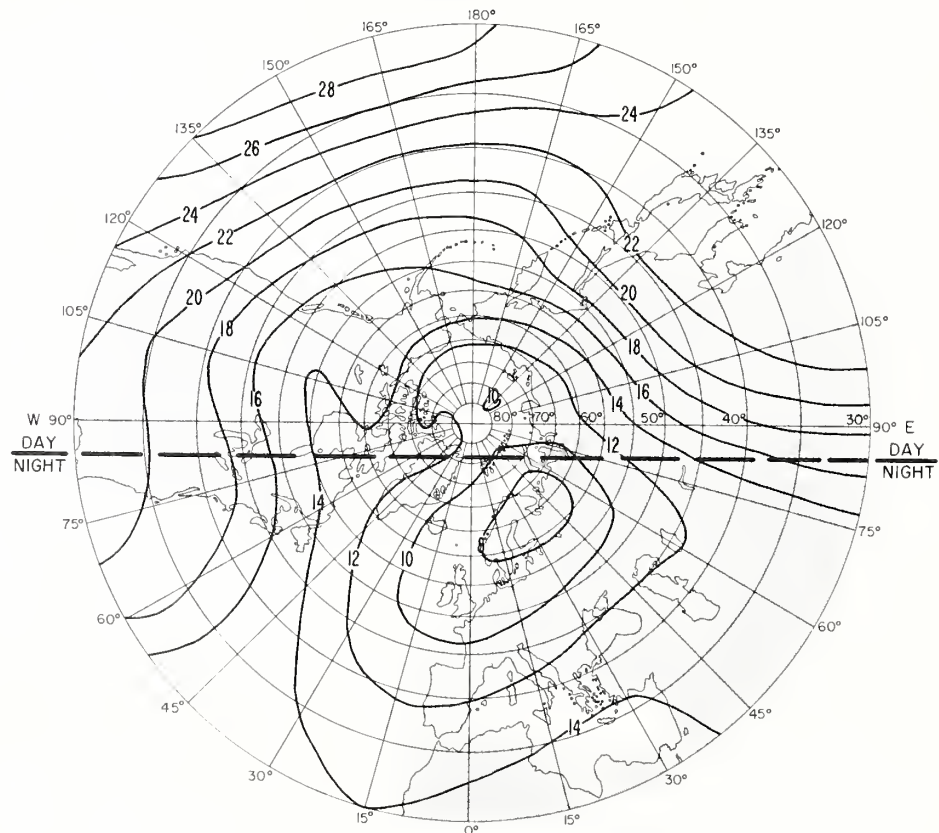


FIG. 13B PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

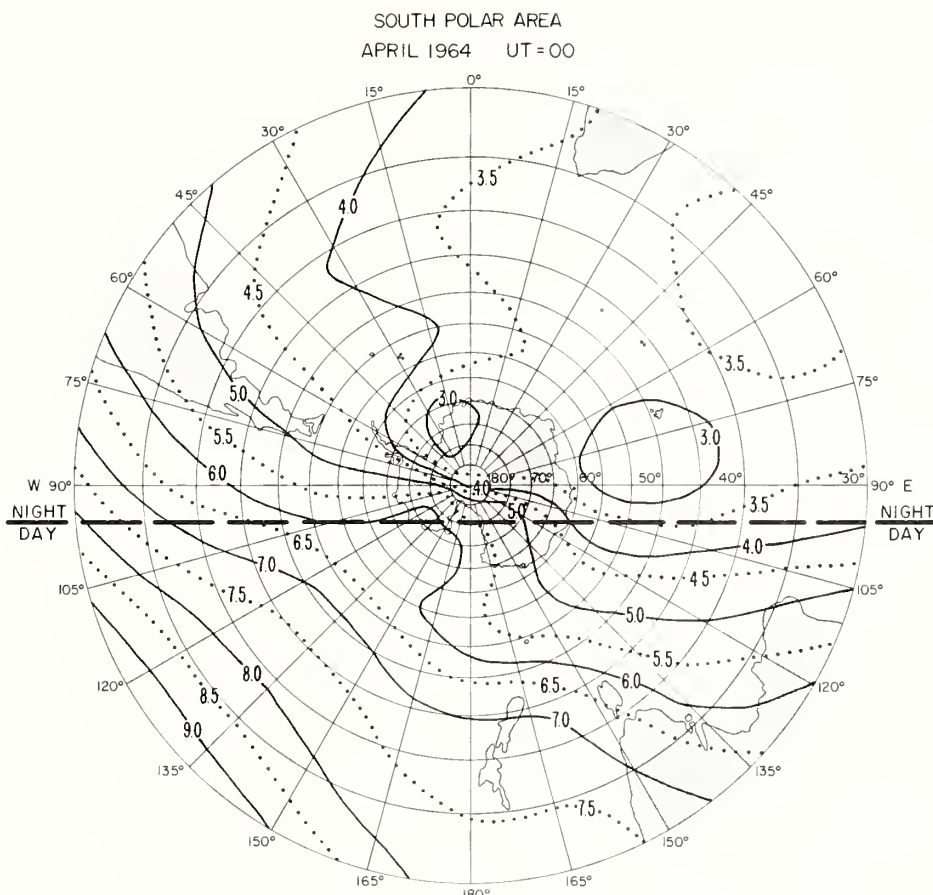


FIG. 14A PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

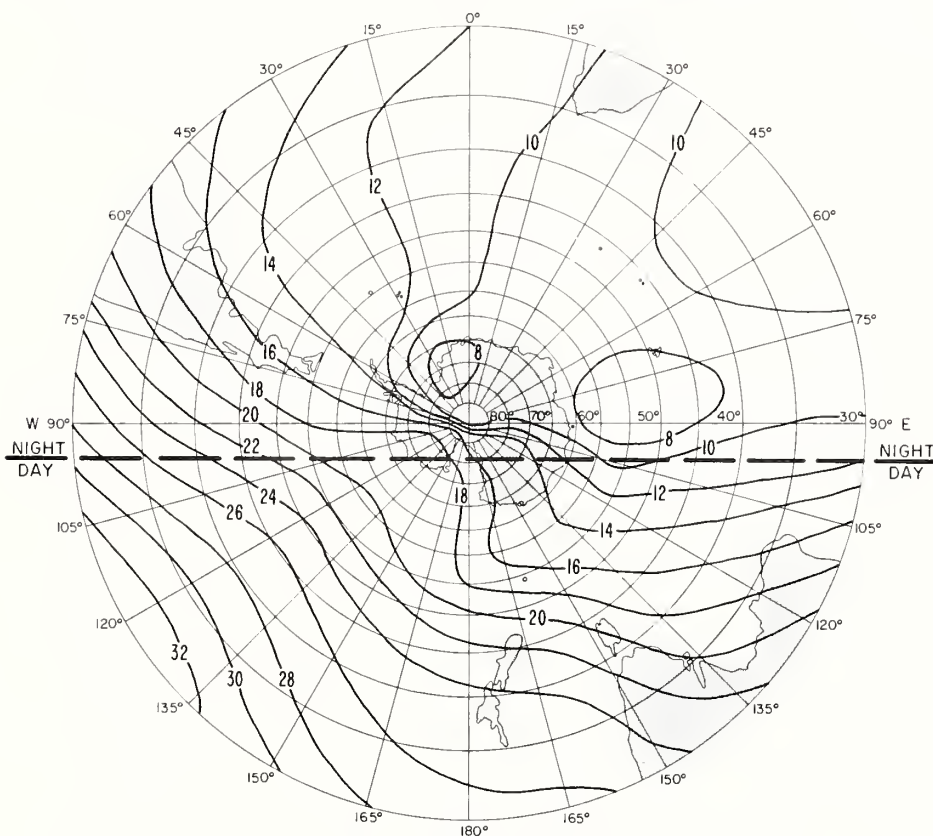


FIG. 14B PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

NORTH POLAR AREA
APRIL 1964 UT = 12

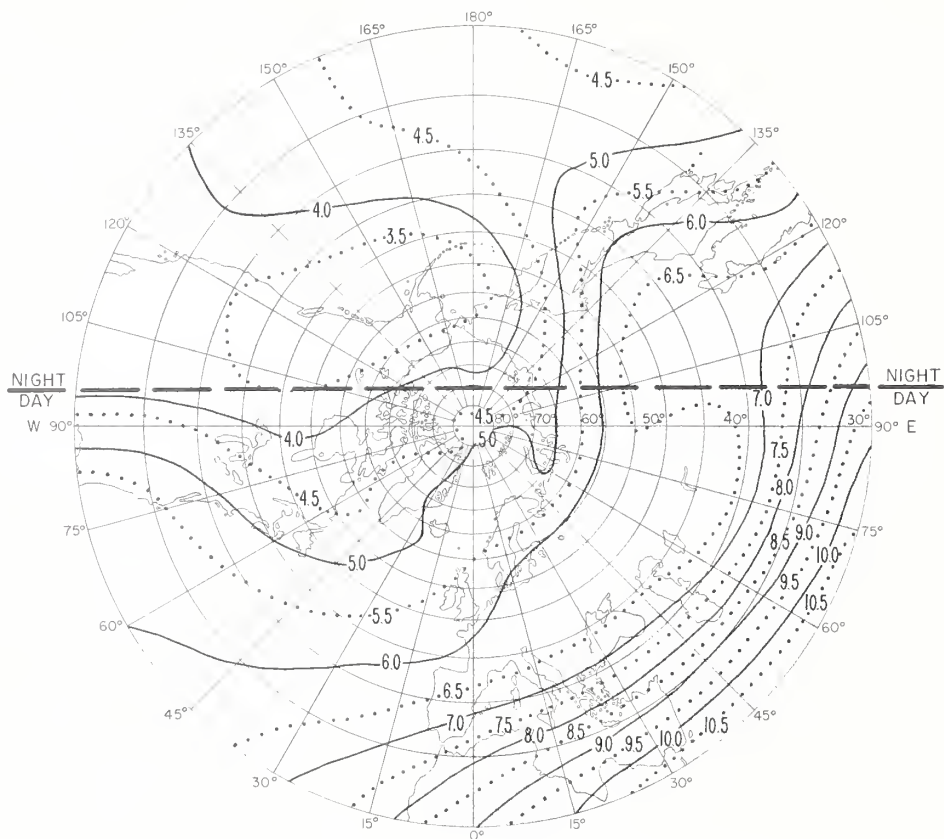


FIG. 15A PREDICTED MEDIAN MUF(0)F2 (Mc/s)

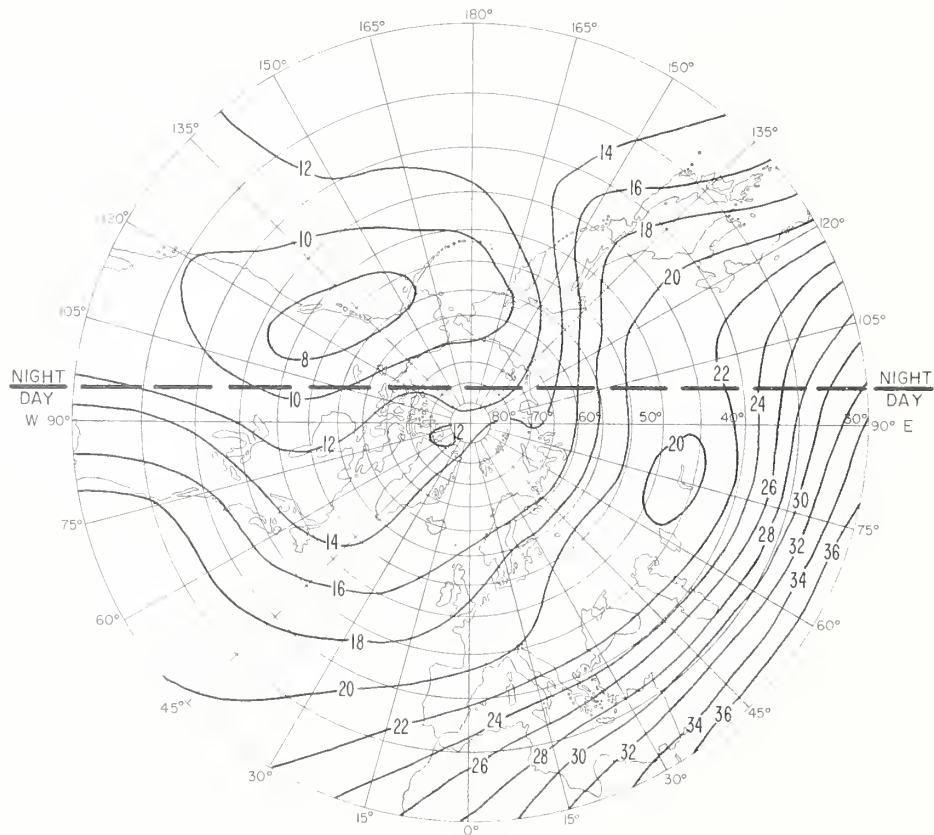


FIG. 15B PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

SOUTH POLAR AREA
APRIL 1964 UT =12

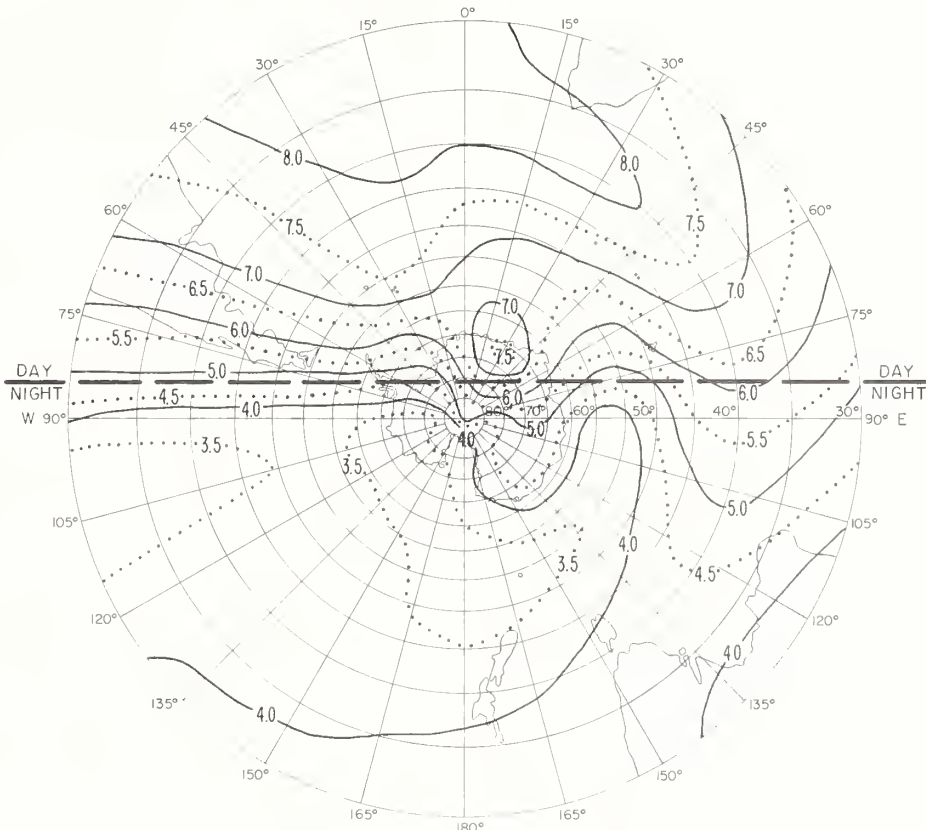


FIG. 16A. PREDICTED MEDIAN MUF(0)F2 (Mc/s)

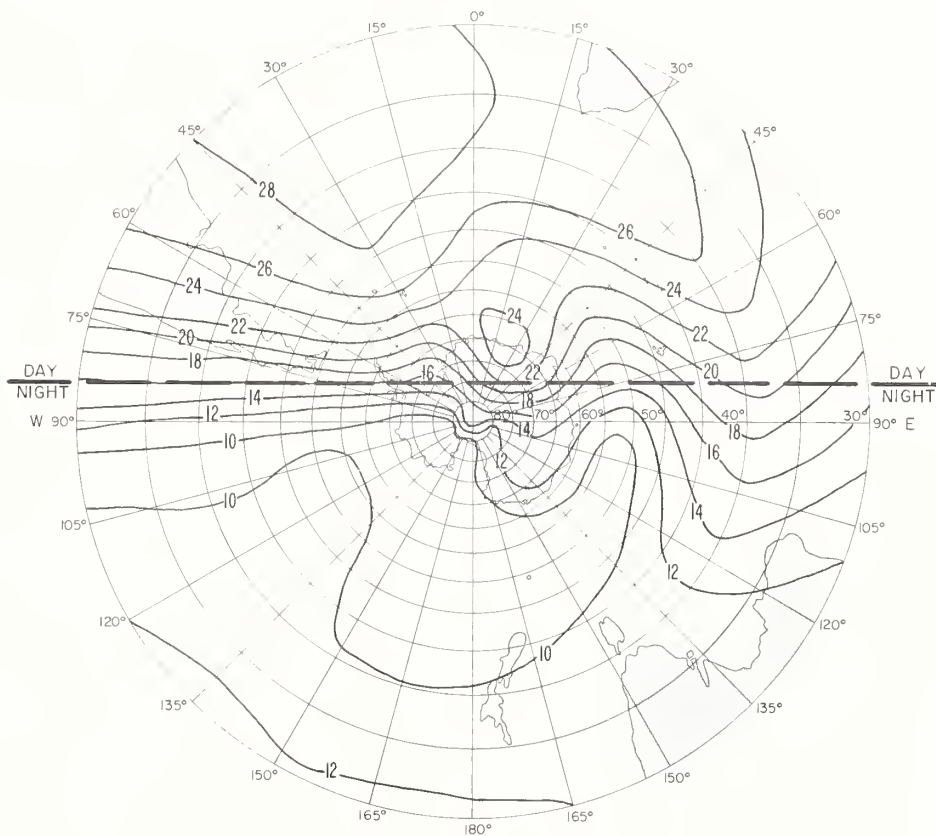


FIG. 16B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

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for
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Based on Numerical Methods of Mapping

NBS Handbook 90 — by S. M. Ostrow — 58 pages — December 1962 — \$0.40

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ERRATUM

Corrections to table 2 in this issue—

s=0, k=26 through k=36 should be blank.

s=1, k=36 should be blank.

s=5, k=28 through k=36 should be blank.

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Office of Weights and Measures.

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Troposphere and Space Telecommunications. Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Spectrum Utilization Research. Radio-Meteorology. Lower Atmosphere Physics.

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NG: None.

USAR: None.

For explanation of abbreviations used, see AR 320-50.